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AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS,
MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

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THE

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JANUARY, 1883.

I. SPEECH IN ANIMALS.

THE languages in which animals converse more or less definitely with other individuals of their own, or of nearly allied, species, were discussed in the "Journal of Science" some years ago (1875, p. 68). The conclusion reached was unfavourable to the common egoïstic notion that speech is the exclusive prerogative of man. That conclusion we are still free to uphold. We regret however that, so far as we are aware, no one has undertaken a formal study of these animal tongues, so as to converse with any of our "poor relations" in their own language.

Commending this subject to the attention of such persons as have the needful time and the opportunities at their command, we wish now to examine the attempts of certain of the lower animals to acquire human speech.

It seems at first sight curious that these attempts have been made with the greatest success, not by the mammalian groups which rank physiologically and psychologically nearest to us,—such as the apes and the Carnivora,—but by certain birds. But we must remember that a number of attributes must coexist in any animal before it can be capable of speech. In the first place, its vocal organs—especially the tongue, the glottis, and the pharynx—must be constructed in a manner equivalent to, if not identical with, the same parts in man. Secondly, there must be a sufficient degree of general intelligence. The animal must be capable of remembering sounds, of perceiving the differences between them, and of connecting them with objects, events, wants, &c. In addition there must be an especial development of

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those parts of the brain which control and regulate the action of the vocal organs. This development, it is scarcely needful to say, is most likely to be met with among gregarious species which require and possess a tolerably complete language of their own.

But there is still a further condition: an animal before it can be expected to learn human speech must be brought into close and friendly intercourse with man. The impossibility, or at least the difficulty, of such intercourse, especially in those countries where experiments of this kind have been generally attempted, is a most serious obstacle. Another kindred drawback is that many of the most promising animals do not—in Europe at least—breed in captivity, and are thus withdrawn from hereditary influence and from a selective development carried on through a number of generations.

As regards the birds which have hitherto acquired some knowledge and command of human speech, there prevails a difference of opinion. The question arises, Do they understand the sounds they remember and repeat, and use them with a due regard to their meaning; or do they reproduce words in the same manner as does a human mimic when imitating the squeak of a pig or the quack of a duck, without any knowledge of or care for signification? The latter is the current opinion. It is maintained that every appropriate, and especially every witty, thing said by a parrot is a mere coincidence. But this view admits of an easy and complete refutation. We ask, Is the bird in the habit of repeating the happy phrases which figure in popular anecdotes, in season and out of season? If so, we might admit that "Polly" speaks merely by rote, and without understanding. But there is good evidence to show that parrots can and do connect their utterances with certain objects, events, times, and other circumstances, and do not therefore speak simply at random. Of this the following cases, for which we can personally vouch, will serve as proof:—A parrot whenever she saw any food being prepared or consumed invariably cried "Give Polly a bit, if you please!"—an exclamation which she was never known to utter on any other occasion. Another was accustomed to have her cage covered over with a shawl at roosting-time, in order to shut out the gaslight: if this was forgotten the parrot cried out very emphatically "Polly wants to go to bed!" This speech she was never known to utter at any other time. A magpie, which belonged to a neighbour of ours at Stowmarket, learnt, without any instruction, the names of several members of the writer's family, rarely failing to utter them on sight of their bearers, but never pronounced them at any other time.

The following case, communicated by M. l'Abbé Gras to "Cosmos les Mondes" (Oct. 21, 1882, p. 297), refers to an African grey parrot which was at first very wild and timid, and which M. Gras has kept for four years in company with a green Brazilian parrot, which was previously very tame, though less intelligent. He names the grey parrot Coco and the green one Cocotte. When being put back into the cage, Coco calls out "We are going to the cage." If a supply of seeds is given her, she says "Here is something good." When swinging, she cries "Coco is swinging." If her companion screams, she says "Come, Cocotte, don't scream; sing!" If Cocotte sings, Coco exclaims "You sing well; oh, very well!" The two birds were walking in the dining-room, and Cocotte began to sing; Coco said "Some one is singing." When asked "Who is singing?" she answered "Cocotte." The latter bird on one occasion went under the sideboard, when Coco, looking down, cried "What are you doing there, Cocotte?" M. Gras was giving some directions to his housekeeper, when Coco exclaimed "How, don't you understand?" The worthy Abbé vouches for the exact truth of all the above facts, and adds that he has numerous witnesses who can corroborate what he asserts.

These and many other authentic cases which are on record, but which it is not necessary here to repeat, show that such birds attach a definite meaning to certain phrases, and use them just as do we human beings. The contention may still, however, be raised that such birds do not understand the individual words, but merely the phrase or sentence as a whole.

Supposing, however, that this is the case, we must admit that such is the precise manner in which human children acquire the knowledge and use of language. The child learns a phrase as a whole, connects it with the object or occasion to which it is appropriate, but does not for some time resolve it into its component parts and employ these in new combinations. But we have observed that intelligent parrots do occasionally vary their stock phrases by fitting in additional words or leaving out some of the old ones. Thus a parrot belonging to the present writer one day saluted a lady visitor with "Good morning, duckey!"—a combination which the bird had never heard.

Another interesting point of comparison here appears between young children and parrots. Talking birds, as far as we are aware, never speak in the first person. The parrot, addressed as "Polly," speaks of itself as "Polly"—that word being the symbol for its own personality. But this holds good of young children also. The child always accosted as "Baby" speaks of itself as "Baby," using the third person instead of, as in after life, the first; or, in other words, the child uses its own name instead of "I" or "me."

There is yet a further similarity: a parrot, when trying to learn a new phrase, often blunders, especially about the last word or words. That of the present writer's, above referred to, was lately studying the phrase "Who's a rogue?" For a couple of days she repeated "Who's a — Who's a who — ?" till at last the final word got fixed in her memory, and she ejaculated "Who's a rogue?" with great emphasis. Something closely alike is traced in young children when learning to talk; they also bungle and break down over the latter portion of a phrase, and, when it is fully mastered, use it for a time both in and out of season.

Thus it would appear that, as far as the use of language is concerned, the intellect of an African grey parrot is on a level with that of a child about eighteen months of age.

We are often asked, ih reference to this point, Why does the child continue to acquire greater powers of language, to retain a greater number of words, and to combine them as occasion requires, whilst the parrot soon comes to the close of its literary education? The answer, surely, is not far to seek: the child is descended from hundreds, perhaps thousands, of generations of talking animals, and inherits the gradually accumulated aptitudes of its forefathers. Merely, however, let us remember, the aptitudes, for the child brought up apart from human society does not inherit articulate speech.

With the parrot the case is totally different: she inherits merely the tendency to scream and whistle, and, as far as language is concerned, she is a sheer parvenu who has risen by her own exertions, without any ancestral resources.

We know of no case of an African grey parrot (*Psittacus erythacus*) having reproduced its species in Europe.* Were this to be done the young birds would doubtless be feeble, and die out. But the experiment might be tried with this species, say at Madeira, or in some locality not too inimical to civilised man. Or it might be attempted in temperate South America with *Chrysotis amazonica*, which is said to be even more docile and intelligent than the African grey parrot. If a pair of clever parrots were matched, and the experiment were carried on for several generations with their offspring, always selecting the most docile and intelligent birds, there can be little doubt but that most interesting results would be reached. The adaptability of the vocal organs to articulate speech, the power of the brain to regulate and co-ordinate the action of the muscles of those parts, would assuredly undergo a gradual development. In like manner the memory for words, and for their connection with the objects which they symbolise, would be strengthened. What ultimate end might thus be reached it is impossible to predict. Perhaps in these days of cram and of the equal rights of animals we may, in five centuries, have magpies in the "fifth and sixth standards," macaws preparing for the examination of the Science and Art Department, and cockatoos—"sweet *bird* graduates"—taking their degrees at the University of London.

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* A bird of this kind belonging to a contributor of the "Journal of Science" laid two eggs last summer.

(A cantankerous acquaintance who sometimes intrudes into our sanctum, looking over our shoulder, remarks that we have already reached all these results.)

In sober sadness we trust that such experiments will be carefully undertaken and carried on for the needful length of time. Of time, indeed, there must be no stint, for parrots arrive but very slowly at maturity.

So much, then, for birds. But how about talking Mammalia? We can scarcely deny that the anthropoid apes, the dog, the cat, the elephant are more intelligent than the parrots, ravens, magpies, starlings, &c. It is generally admitted that they understand our spoken language to a very considerable extent, even in matters where tone, gesture, or expression of features throw no light at all upon our meaning. We know instances where words of reproach, though intentionally uttered in a mild tone, have been at once comprehended both by dogs and cats.

A very intelligent dog described by M. A. Roujon* will, when ordered by his master, fetch, without ever being mistaken, his pipe, tobacco, a knife, a fork, &c. When he hears merely the word "sport" (*chasse*) he rushes to his master's gun. This dog belongs to a M. Antoine Barthomeuf, who keeps a café in the Place de l'Eglise, at Chamalières, near Clermont-Ferrand. But why, then, as mammalians so clearly understand and remember our language, are they so little capable of acquiring its use? We will admit that it is, for the majority of men, easier to understand a language than to speak it. But this well-known fact is far from explaining the difficulty. Does it lie in the different structure of the vocal organs? This difference in the higher apes is but trifling. In the Carnivora it is greater; their tongues are relatively longer and slenderer, and better adapted for lapping up liquids, or for licking and rasping the bones of their prey, than for going through the various evolutions within the mouth required for the production of articulate sounds. The voice of the cat is deficient in compass, and that of the dog is too abrupt and jerky. The anthropoid apes, though given to converse among themselves with great volubility, have never been brought sufficiently long and closely under human influence; they have never been known to propagate in a domestic condition, and their lives in captivity in Europe or in the United States are short and sad, since they are soon attacked by disease. Hence the opportunities for teaching them to talk have been insufficient. We should suggest that the attempt should be made, say at Calcutta, or Buitenzorg in Java, with the mias or the chimpanzee, just as we have suggested above in case of the parrots. The difficulty would be how to give these animals the freedom necessary for their health and vigour, and yet to bring them in sufficiently close contact with their keepers. We should propose that the course of training should commence with pregnant females. The young should then be brought from infancy into the society of kind and intelligent keepers, who should teach them to speak, those which showed the greatest aptitude being selected as the parents of the next generation.

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* Revue Internationale des Sciences Biologiques, 1882, No. 10, p. 348.

Meantime it must not be forgotten that there are some Mammalia which have, in rare instances, been known to utter a few words. Among these is the common seal,—a singularly docile, affectionate, and intelligent creature, which might well claim at the hands of man a better treatment than to be massacred for the sake of its fur.

There have been various anecdotes of talking dogs, but the only instance which is duly authenticated is that of the dog of Clermont-Ferrand, above mentioned. This dog, a setter, can, according to M. Roujon, utter the words "*ma maman*." "To make the dog speak," says this author, "it is necessary to stand before him and bid him pronounce the words *ma maman*, showing him some bread or meat. The dog then becomes agitated and growls, but on repeating the demand he at length decides to speak. He pronounces at first feebly and indistinctly, but on telling him to speak more distinctly he gradually finds his voice, and finally pronounces the words demanded very distinctly." This performance, we learn, has been repeated before a great number of persons at Clermont. The same dog, further, if his master has shot and brought home any game, runs of his own accord to the kitchen to seek a knife, carries it to his mistress, and addresses her as *ma maman*.

MM. Gallois and Gory, friends of M. Roujon, state that they have met with several dogs who pronounce distinctly some words,—amongst others the word *non*. It is indisputable, as M. Roujon remarks, that by applying to such animals a methodic selection prodigious results may be obtained. Prof. Max Müller's " Rubicon " may be dried up in a manner plain even to the most prejudiced.

II. PATENT-LAW AMENDMENT.

By An Old Technologist.

FOR some dozen years or more we have, as a nation, come to the very wise conclusion that the Patent Law of the United Kingdom is not all that might reasonably be demanded, and that, in well-known phraseology, " something ought to be done." What that something is and who is to do it are further points upon which we are by no means agreed. It is, in the first place, to be regretted that neither of the great political parties seem willing to take the matter heartily up. Precisely because it is everybody's business it is nobody's. Hence while questions which are in comparison light as air—or rather as hydrogen gas—can secure the attention of the Administration and of Parliament, Patent-Law reform is shelved,—put off to some indefinite epoch. That this should be so is discreditable to our national prudence and common sense. Without a good Patent Law we shall have no inventions and improvements, and without inventions and improvements we cannot hope to hold our own in the intensified struggle for business which is so characteristic of modern times. A statesman of the present day has openly expressed his satisfaction that we have no longer a monopoly of the world's manufactures. Will he and his friends, then, do nothing to place us at least on terms of fair equality with our rivals? Or are we to go on, as we are at present, heavily handicapped in the race?

But though Parliament has done nothing, and does not for the present seem likely to do anything, certain societies have taken the matter up, and have expressed opinions which will not be without influence upon the nation, and in due time upon the Government. Among these may be noticed the Philosophical Society of Glasgow, and the Society of Arts, which has taken the trouble to draft a Bill to be introduced into Parliament if that august body has ever time for the consideration of so plain and matter-of-fact a subject.

More recently the Council of the Society of Chemical Industry has resolved upon certain "recommendations," which have been widely circulated and which are influentially supported.

It may, perhaps, seem presumptuous for a mere private individual, holding no official position, to dissent from opinions put forward by such high authorities, and to proclaim their recommendations unsatisfactory; yet I feel compelled so to do, and I can only hope that the grave importance of the subject may be accepted as an excuse for the liberty I am about to take.

In the first place it must be asked, What do we aim at by a new and improved Patent Law? Do we seek to encourage and attract invention, or to drive it away? On the answer to this question the character of the recommendations to be proposed, and of the law to be enacted, must hinge. If we have the former purpose in view,—if we wish that invention should abound and flourish among us, that our working-men in every department of industry should be constantly seeking to improve the processes now in use, and that foreign inventors should flock to England as the best sphere for the practical carrying out of their ideas,—we must seek to give greater facilities for protecting the property of the inventor in the work of his own brain than he can meet with elsewhere. This is not the case at present. And we must venture to remind those cynical freebooters who tell us that the inventor will go on inventing whether we protect him or rob him, that if he finds himself robbed he may carry his future inventions elsewhere.

A regard to our own future, an enlightened self-interest,—

leaving equity out of the question,—bids us therefore see to it, that the inventor is not compelled to go elsewhere.

What is needful for this purpose? We must grant patents for a longer term than do our rivals; we must grant them on easy terms as to fees and duties; and, above all things, we must secure for patents once granted an absolute duration. In all these points we offer less instead of greater facilities to invention than do some of our industrial rivals. Let us take the most formidable of these rivals, the United States of America. In that country the property of the inventor in his ideas is secured for seventeen years, whilst we grant him only fourteen years. Secondly, the expense of taking out a patent is, as is perfectly well known, a mere fraction of the charges incurred in this country. But the most important point in favour of the system of patents of the United States is what I must call its certainty or fixity. A. B. has invented, say, a new method of manufacturing soap; he has paid his fees, and received the official document certifying his rights. From that moment to the expiry of the seventeen years the patent is his absolute property, unless of course it is set aside by the decision of a Court as being wanting in novelty, or as being an infringement of some prior patent. No act or omission on the part of the patentee can render his patent null and void. In the United Kingdom a totally different system prevails, to the disadvantage of the inventor. He is called upon to pay £50 at the end of the third year, and a further sum of £100 at the expiry of the seventh year, failing either of which sums the patent is forthwith void, and the invention becomes public property. Now the effects of such a system are self-evident. Every person who wishes to have the use of the process, and who otherwise would negotiate with the patentee for a license or for the purchase of his entire rights, is induced to wait, in the hope that the patentee may fail to pay the £50 duty at the end of the third year. This is especially certain if the inventor is known or suspected to be poor,—a state of things far from uncommon, as his means are often much reduced by the cost of perhaps a prolonged course of experimentation. Hence, therefore, capitalists have a distinct inducement given them to hold back, which in America does not exist.

Now it has always been a mystery to me how it comes that genuine Patent-Law reformers—men who declare themselves the friends and promoters of invention—do not perceive the necessary effects of this system of intermediate payments. So far are they, however, from recognising the truth of this consideration, these payments—modified perhaps in date or in amount—are retained in almost every suggested scheme for a new Patent Law. Nay, in one proposal, which would have lengthened the lifetime of a patent to twenty-one years, a *third* intermediate payment was adopted, thus giving the patent three chances of lapsing.

In the abortive Patent Bills introduced by the late Ministry, and fortunately withdrawn, there was a clause which seemed to me particularly objectionable and dangerous. It was proposed that if any patent had not been brought into use on the large scale by a fixed term of its career, it should forthwith lapse and become public property. Such a proposal did not appear surprising in Bills which were, almost avowedly, drawn up on the assumption that patent-right is an abuse and a nuisance,—a "monopoly," as some call it, in flat contradiction to the authoritative definition of monopolies laid down by Coke,—to be curtailed as much as possible. But the public may well think it strange to find the same suggestion put forward among the recommendations of the Society of Chemical Industry. They propose, namely, that if a patent has not been brought into operation upon a large scale by the fourth year it is to lapse, the invention of course then becoming public property!

There are certain plausible considerations which have led to this proposal, which is a too literal carrying out of the saying "From him that hath not shall be taken away even that which he hath." Its supporters will doubtless argue that if a patent has not been brought into extensive use on the large scale within the very short time specified, it must be practically valueless, and may consequently be cancelled without injury to the patentee, and with benefit to the community at large, who may then at leisure avail themselves of any useful feature it may possess. Such considerations on a close examination, undertaken with an eye to equity, soon show themselves to be fallacious. It is certain that the eagerness of the public to avail themselves of a patented process bears no direct proportion to its utility. We do not find that a patentee is, as soon as his letters patent are duly sealed, overwhelmed with applications for licenses or with offers to buy the whole or a portion of his rights. Quite the contrary; he is obliged to go out and seek to bring his improvement under notice. He must go round like a traveller seeking for orders. He must exhibit and read papers, and correspond. Now all this requires abundant time, thorough business tact, and plenty of money. Is the Council of the Society of Chemical Industry prepared to assert that an invention is valueless unless the inventor possesses these three properties? As the Law stands it may safely be asserted that if a patent comes into extensive use by its seventh year the inventor may think himself fortunate. The only exceptions to this rule are when he is a capitalist, or has the ear of some capitalist or syndicate who may be willing to put the new process in operation.

Such, I say, is the case as the Law now stands. But if the proviso which I am criticising be incorporated in the proposed new Act the case of the patentee will be infinitely worse. It will then be impossible for a poor man, or for one who is not a man of business, to hold a patent beyond the fourth year. The manufacturers and others concerned will say, as they now say with reference to the third year's stamp-duty, "Don't pay license to this troublesome fellow, but wait till his rights lapse." They will be able to say this with more confidence, for it is often much easier to raise the £50 for the third year's tax than to force an invention into use in the face of a conspiracy of neglect. Consequently, if this extraordinary proposal becomes Law, it will be an act of folly in anyone not a capitalist, or enjoying exceptional facilities, to take out a British patent at all. If he devises anything useful, I should in that case recommend him to carry his idea to America, where he will meet with a more liberal, and I will venture to add a more honest, treatment.

Summing up this part of the patent question, it may be said that to declare a patent at an end if not taken up within a certain time is to ensure that it will not be taken up.

There is, however, one particular case in which the liability of a patent to determine, unless put in practice on the large scale, might be usefully, and I believe justly, introduced. It is well known that the original object of patents was the introduction of new arts into these realms, and the improvement of those already therein existing. This becomes perfectly clear if we read over the preambles of some of the older patents. But as the Law now stands, and as it is now worked, it is made the instrument of keeping certain arts *out* of Britain. It is very common for aliens to take out a British patent, not with the intention of working it on British soil, but of preventing anyone else from so doing. They either refuse to grant licenses at all, or they demand royalties which are practically prohibitive. Now it would be prudent to decree that if an alien takes out a patent in Britain, and in some other country, and works it in such other country but not in Britain, his British patent shall then lapse. It might be well to add that if a British patent exists for the manufacture of any article, the importation of such article from abroad shall be prohibited.

There is another defect in the present Patent Law which is very objectionable, but which, singularly enough, is quite overlooked by the various bodies who have issued proposals for its amendment. Our present system is in one respect a step backwards from what is known as the "Old Law." Separate patents were indeed required for England, Ireland, and Scotland; but the English patent, on payment of a small additional fee, covered "all her Majesty's possessions and plantations abroad." I have never seen any reason, or shadow of a reason, why this Imperial scope of a patent was abolished. It was once said, in an off-hand manner, when the subject was mentioned in Parliament, "Oh, the Colonies have got their own Patent-systems." Precisely; and this is the very evil complained of. If an inventor wishes to have his invention protected throughout the whole British Empire he has to pay altogether about £1200. Now it is not within the power of the Imperial Parliament to extend the hoped-for new law to those colonies which have quasi-independent legislatures. But India and the remaining colonies might be included with the home kingdoms. Nor do I think that Canada, Victoria, New South Wales, &c., would object to come in, since their Patent Offices would then—like that of London—have the power of granting Imperial patents, which would obviously be of much more value to inventors than the present local ones.

There is a further innovation which I venture to think would be of great public utility. Following the wise example of Germany, we ought to exclude proprietary medicines, foods, beverages, and substitutes for foods from the benefits of the Patent Law. By so doing we should strike a deadly blow at quackery, and at various phases of fraud and adulteration.

III. ON ANTHROPOLOGICAL FORECASTS.

By F. Ram.

ARE Darwinian principles to be set aside whenever the future of mankind forms the subject of philosophical speculation; or is the theory that all organised beings are fashioned by the environment—a theory now generally admitted to be true as regards the development of our species hitherto—to be considered to hold good for the bimane of the future also? No Evolutionist would, I suppose, maintain in so many words that there exists an immutable destiny, which will of necessity exalt generations to come into a higher rank—mental, moral, and physical—than man now holds, whether the circumstances which beset our race are favourable to such desirable amelioration or are antagonistic to it; and yet how many anthropologists, when dealing with the subject, appear to be led by their optimistic prepossessions into a practical abandonment of the theory that the direction of development is dependent on the conditions of life. The lesser lights do, indeed, follow high authority in thus sacrificing (as it appears to me) scientific principles to philanthropical aspirations, for we find Mr. Herbert Spencer expressing his undoubting confidence that "the things we call evil and immorality will disappear," and that man must "become perfect;"* whilst by Mr. Wallace we have been assured that, of the race which will some day people the earth, no individual "will be inferior to the noblest specimens of existing humanity."† But surely, so long as we cannot demonstrate beyond dispute what the conditions of life will be in the time to come, and can show from the experience of the past that such conditions invariably produce such and such results, the confident anticipations of this description which one so frequently meets with must be held to be most unscientific, being born of faith and hope only, and resting on no sure foundation.

If two codes of ethics—a superior code A and an inferior code B—were placed before a philosopher of the optimistic school, and he were asked which he supposed would ultimately prevail in the earth, he would give his confident decision in favour of the higher code. And this, indeed, he might very reasonably do, if he could first prove that the future environment must of necessity be such that those persons whose innate disposition most readily led them to accept and to follow its excellent precepts would multiply more rapidly than the baser sort of men, prone to reject them in favour of those maxims of the lower code which, by natural bias, they prefer and adopt as their guide in life. But should the conditions of human existence become such that the lovers of B code multiply faster than the lovers of code A, how then ?

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* Social Statics, Chapter I., "On the Evanescence of Evil."

† Anthropological Journal, March 1, 1864, p. clvii.

Why have not the noblest ethics, which have been proclaimed in the world for thousands of years, become practically operative in the lands in which they have been taught ? Is it not because those better men, to whose hearts they were most acceptable, have not in the struggle for existence, and in the art of rearing descendants to inherit their qualities, been blessed with a corresponding advantage over the more ignoble beings, who by natural disposition were indifferent to, or positively opposed to, them ?

Even if it could be shown that humanity is making an ethical advance in the midst of its present surroundings, a very reasonable apprehension must occur to thoughtful minds, that the conditions of life affecting morality may be very terribly changed on the arrival of that—by no means very distant—time when the rapid increase of our species, and the concurrent exhaustion of that element of the fertility of the earth's surface, which consists of the decayed animal and vegetable matter, which has been accumulated therein during past ages, combine in bringing about a general scarcity of food all the world over ; and the question becomes one of who shall be fed and who shall starve—a state of things which, once begun, seems—for anything that appears to the contrary—likely to last.

That professed teleologists should expect an advent of final moral perfection in every nation under heaven is not, perhaps, very surprising ; but such an anticipation seems to be very inconsistent with pure scientific principles, the odds against any such result arising independently of purposive control being surely almost infinitely great.

The relative rapidity of multiplication of each grade of intellect will also decide the question as to man's mental advance. The teacher may strive to impart knowledge to the individual, and to strengthen his mind : but the question of the rise or fall, from age to age, of the intellectual capacity of the species will lie with Natural Selection. That the factors affecting the psychical development of the *Anthropidæ* hitherto have been bringing about what we consider to be improvement is no proof whatever that such progress will continue. It may, or it may not. Positive assertions either way are equally without warrant. But with regard to the conditions which appear to affect the question at the present day we may note one of some importance, which is too often, I think, disregarded. By looking around us we may see that present circumstances generally favour the social rise of the more intelligent individuals of the lower classes of the community. Hence many such persons are drawn out of those strata of society that earn their bread chiefly by using their muscles. It is, I believe, certain that by such abandonment of bodily labour they lose something in prolificacy. An analogous result among lower animals might lead us to expect this. It is because fertility is increased by physical exertion that farmers often put bulls to hard work. An experienced breeder of horses told the Lords' Committee on Horse-breeding (1873, Qu. 1157) that a horse could not be travelled too much. "The more the horse is travelled the more foals."* Common observation leads us to the conclusion that this physical law holds good for mankind also, the large family of the labourer being notorious. Thus stupidity, by keeping a man in the ranks of labour, may increase the comparative abundance of his offspring (inheriting his dulness). This must tend to keep down, if not to lower, the average intelligence of many communities.

Mr. Fiske tells us, in his "Cosmic Philosophy," that though "mankind is destined to advance during future ages in psychical attributes," he "is likely to undergo only slight changes in outward appearance."† On the other hand, we have the opinion of Mr. Herbert Spencer‡ that in the

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* In this fact we ought, I think, to see that not only is it incorrect to suppose (as is commonly done) that "Survival of the Fittest" is to be taken as necessarily equivalent to the nearest approach to supposed ideally perfect animal types,—which is negatived by those instances of development (of either species or individual) which result in so-called "degeneration,"—but also that it is not a matter of course that Natural Selection will always bring about the closest adaptability of a species' capacity to its needs. For in the case of those creatures which unite at the time of year when their food is abundant, a defect in the power of procuring nutriment might entail so much more physical labour in the defective individuals that their extra exertions make them so much the more fertile than those which become plethoric, through their being endowed with superior power of obtaining their food with ease. Thus in some cases a check may be put upon the plenary organisation of a species by Natural Selection, and the less perfect animal may thus have the higher claim to be called "the fittest."

† Part II., Chapter XXI.

‡ Principles of Biology, vol. ii., Chapter XIII.

"further evolution in the most highly evolved of terrestrial beings," "augmented bulk" may form a feature—smaller dimensions not being apparently an admitted possibility. To deny that man may become bigger than he is would be to lay just such a claim to a superhuman acquaintance with his future environment as has been deprecated above. But although such knowledge is unattainable, attention may be drawn to the fact that man's present outward circumstances appear to favour a reduction of his bulk; and indeed it can hardly be doubted that in our manufacturing towns considerable progress has already been made in that direction,—man in this respect following the example set to him by a vast number of other genera.

As compared with those of the animal kingdom at large, human dimensions are prodigious—a million times greater than those of the creatures which, at least in regard to social qualities, rank next to him. The drawbacks to such massiveness in beings which have to move themselves over a planet, at the surface of which the attraction of gravitation is so great as it is on this globe, are clear enough; but the evils attendant thereon have been, as far as concerns man's development in the past, more than counterbalanced by other considerations, chief among which was warfare, personal and tribal. During all the ages in which woman was the object of violent contention, a capacity to deliver a blow from a greater height (and with consequently accelerated speed and corresponding force) than lay in the power of an opponent, was of sufficient importance to a candidate for feminine favours to counterbalance many disadvantages resulting from ponderosity. (Indeed so soon as our hirsute ancestors were sufficiently advanced to wield a club with the right arm, the attainment of the erect posture—if not already reached—must have been greatly expedited by this one consideration.) It is probably on this account that good height in man, in order to gratify our inherited æsthetic taste on the point, must be from the shoulder downwards, and must not be chiefly consequent on the possession of a long head and neck. For the same reason, too, boys, though not taller than girls up to the age of about thirteen, shoot up above them as they approach the age at which their forefathers fought with their right arms. The prevalence of the use in battle of weapons of precision, in the place of arms which gave due advantage to personal strength, must, on the contrary, tend to reduce human stature, each bullet being the more likely to fulfil its mission the bigger the man against whom it is despatched. The general substitution of machinery for manual labour may be expected, however, to produce a much greater effect than the change in the nature of homicidal weapons.

That the inhabitants of manufacturing towns should be seen to be "degenerating," as the process of their reduction in stature is—as I consider very inconsiderately—termed, is a matter of lamentation to many writers, who apparently can only regard the smaller individuals as stunted, or checked in growth by their evil physical surroundings; whereas it may, surely, be more reasonably regarded as purely a case of natural selection. Are not little people as competent to control machinery as their larger mates; and are they not therefore able to earn as good wages at such occupation? As they cannot need to spend so much on food, clothes, or even house-room, they are clearly so far at an advantage in the struggle for existence with their more bulky competitors, and are therefore so much better able to wed, and increase and multiply, and to rear the (diminutive) offspring which they produce. In the past the big men have had, on the whole, the better chance of transmitting their dimensions to succeeding generations. In the coming age of machinery the smaller men are more likely to transmit their diminutiveness.

Inherited sentiment may indeed check the speed of this dwarfing process, the smaller people having usually a natural liking for taller mates. But this feeling will die out; for the possession of it, inasmuch as it may affect the matrimonial selection, will be apt to lessen the number of an individual's descendants. And thus in every generation there will be a greater proportion of marrying people, who, far from sneering at small stature in the opposite sex, will—on the principles explained in my article on "Beauty" (No. XCVIII.)—delight in it.

This continued reduction of stature may very well proceed, I should suppose, at the rate (say) of an inch in a century. And, since the advantages of the change are more apparent than the drawbacks thereto, it seems not unreasonable to expect that the operation will thus go on till a very great change is effected. The smaller mankind become the more elbow-room there will be in every situation, and in greater comparative abundance will be all the products of the earth's crust. At the present time, moreover, man is able to transport himself rapidly from place to place only on roads specially made with much labour and at great expense. A material diminution of his weight would go far to facilitate aërial locomotion. And it is not, indeed, an altogether unreasonable supposition that man (should the Struggle for Existence in the ages to come be so intense as to reduce him to a pigmy) may succeed in training birds to waft him hither and thither in any required direction, the advantage to the individuals first capable, on account of their lightness, of being so transported increasing the tendency towards the reduction of the average weight of the species. Such an achievement will not appear impossible except to those minds which can only run in familiar groves. But far be it from the present writer to put forward any idea whatever anent the human future with that unquestioning confidence with which so many philosophers are in the habit of forecasting it,—as to mind, body, morals, manners, circumstance, and everything else,—and which, indeed, being without corresponding support, must be considered as unscientific and indefensible.

IV. COMPOUND ORGANISMS AND THEIR LESSONS.*

SOME time ago ("Journal of Science," 1882, p. 401) we gave a sketch of the characters which mark the development and reproduction of the Protozoa as compared with the same processes in the higher animals. We showed that as regards the former the terms "birth" and "death" have scarcely any meaning, or at least a meaning quite other from what may be traced in larger and more complex beings. We hinted, too, at startling questions touching personality and individual identity which a study of the Protozoa cannot fail to suggest.

We will endeavour to carry the subject a little further, at least as far as organic individuality is concerned. Let us turn our attention to the opposite extremity of the organic scale,—if at least Professors Minot and St. George Mivart will pardon us for speaking of man as the highest animal. One of the plainest characters in a man—or we might say in every normal vertebrate animal down to the humblest fish—is his complete isolation from the rest of the world. He stands in no physical connection with any other portion of matter, living or lifeless. He has certain well-defined boundaries, which even the least scientific observer cannot mistake. Of what takes place within that boundary he is conscious. Of what happens beyond his consciousness gives him no information.*

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* Chapters on Evolution. By ANDREW WILSON. Chapter XIII.

Hence, as regards individuality or personality, the higher animals seem to contrast sharply with those minute and simple beings which are one with each other and with their *quasi* forefathers. But this contrast is only in seeming. There are stages or grades in individuality. There are animals concerning which we must pause whether to pronounce them independent beings or parts of some larger totality. We may even be compelled to answer this question differently according to the point of view from which it is approached. The creatures in question are the so-called compound or "colonial" organisms, of which the sponges, the Hydræ, &c.,—all, be it remembered, water-animals,—are familiar instances. Such an animal is at first produced from a single egg, and may thus claim in one sense to be regarded as a well-defined individual; for whatsoever springs from *one* egg may fairly claim to be regarded as *one* animal, just as whatever springs from *one* seed is considered to be merely *one* plant, and not an indefinite number of plants. But the zoophyte—say the common *Sertularia*, or sea-fir, so called from its resemblance to the sprays of a fir tree—consists, again, of multitudes of animalcules, each resembling a Hydra. Each such animalcule captures food and digests it; each ultimately dies, and is replaced by others which spring not from eggs, but from buds. Hence the question arises, Which is in reality the individual, the whole spray or the animalcule,—the product of original egg or each bud it has sent out? Scientific zoology considers that the balance of evidence is in favour of the former view, and names the animalcules above mentioned "zooids."

But before coming to a conclusion we must consider some other cases of compound life.

Remarkably curious and instructive is the green fresh-water sponge (*Spongilla*) found growing on woodwork immersed in water, such as piles and sluice-gates. It propagates itself both by eggs and buds. If one of these beings is cut into two or more pieces, each part lives and increases as if it had been a primarily independent organism. Sometimes also they are known to split up spontaneously, each portion starting in life independently, like the halves of a Protozoon which has divided itself. What is still more curious, if two Spongillæ are placed close together they sometimes merge into one individual. Here, then, we have beings where it is impossible to decide by inspection whether any one of them is the produce, and the whole produce, of a single egg or not. Such a *Spongilla* may have divided itself, and one of these divisions may have coalesced with another *Spongilla*, which may be the entire product of a distinct egg or only a part of such product.

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* We do not intend to dogmatise on the question whether a person without any evidence passing through the medium of the senses can be directly aware of ideas or emotions occurring in the mind of another. To take up this subject would be a digression.

Or we may take that fresh-water polype known as the Hydra, which has long been known from the fact that it cannot be killed by mechanical division. Let it be cut transversely, or longitudinally, or obliquely into two parts, or into more, each section becomes an independent Hydra. Naturally it throws out, at its sides, buds, which like itself are each provided with tentacles and with a mouth for capturing and absorbing food. Each such bud grows, and ultimately is detached as a distinct animal. Often before being thus thrown off it puts forth buds, and thus it may be said to exercise all the normal functions of animal existence whilst still united with its parent. At the same time the Hydra is capable of reproducing itself sexually by eggs. Consequently when we find one of these little beings we cannot ascertain whether it has sprung from an egg or from a bud. In the former case it is, according to established views, a distinct animal. In the latter it is only a piece or fragment of an animal, forming a whole along with some other portions not to be identified, if still existing. Yet by no consideration, morphological or physiological, can the one, as it falls into our hands, be distinguished from the other. Each grows, captures and assimilates food, and reproduces itself both by eggs and by buds, precisely as does the other. The individuality and personality of these little beings must evidently be highly complex and perplexing. Up to a certain date the specimens formed by budding have been one with their parent and with each other.

Another somewhat different type of compound or colonial existence is shown in the Flustra, or sea-mat, an animal often mistaken for a sea-weed. On each side of every "leaf," as it is commonly called, we find a multitude of zooids, each inhabiting a little cell and leading an apparently independent existence. Each feeds, digests, and assimilates without—as in the zoophytes—throwing the product of its digestion into one common stock. Each reproduces itself both by eggs and buds. The eggs give rise to new, unconnected individuals, whilst the buds increase the specimen before us. There is no general nervous system, no circulatory apparatus connecting the whole colony together. The removal of a portion, and the death of its zooids, inflicts no perceptible injury on the remaining part. If it be asked how the whole adheres together? the answer is easy: the cell-wall of each zooid adheres to the cell-wall of its neighbour, forming thus a continuous structure. It is evident that while such a Flustra lives on and increases, its component zooids die in succession and are replaced by their offspring, particular life and death succeeding each other within a more general life. As a matter of course an entire Flustra, like an entire zoophyte, is not limited in the number, the shape, and the size of its ramifications. Here, therefore, one of the distinctions between animals and plants proposed by our old master Oken falls to the ground. He maintained that the animal was geometrically and arithmetically limited and definite, whilst the plant was neither. Thus we know the number of the limbs and other parts of a normal unmutilated animal of the higher classes; we know their shapes, and their respective positions. But we do not know the number of branches and twigs which a tree of any kind ought to have, nor yet their shape or their relative positions. But if Oken had taken the zoophytes into consideration he would have found in the entire animal—*i.e.*, in the product of a single egg—as little regularity of form and number as in the tree, the product of a single seed. Definite regular structure is found in the one case in the zooid, and in the other in the flower-bud.

But an indication or forthshadowing of compound life may be traced in higher forms than those which we have just been considering. Among the Annuloida we find a well-known and disreputable being, the tape-worm. This creature has indeed a head, but otherwise it consists of a multitude of segments familiarly called "joints," each of which has to some extent an independent individuality. Each joint has its own set of sexual organs, both male and female, and may be regarded as a bud thrown off by the head. It may, however, not be judicious to attach too much weight to this example of the tape-worm. Like parasites in general, this animal has reached its present position by a process of degeneration or retrograde evolution.

The Naididæ, however, afford us a case of compound life in the great group of the Annulosa. *Cirrhatula*, a genus near akin to *Nais*, is reproduced by budding, and, as we have seen, budding involves compound personality. Both *Cirrhatula* and *Nais* are water-worms, provided with tentacles at the head, and with a pair of leg-like processes attached to each segment. If one of these creatures is observed for a sufficient length of time it will be found to be constricted at some point towards the hinder part of its body. The part behind the constriction or narrowing grows in length, gains more segments each with its legs, and develops a head with eyes. But it still for a time remains attached by its head to the mother, from whom it derives its sustenance. It may happen that before the young individual has become fully perfected, and detaches itself, a third portion begins the process of assuming a distinct organisation. Thus Prof. Müller found three individuals adhering together in one length in a manner that may be familiarly illustrated by a link of sausages. "The mother had thirty footed segments; the youngest daughter, or the one nearest the mother, had eleven, but the head was not yet developed. The most remote had seventeen rings, with a head and eyes, and the tail of the mother. The intermediate specimen had also seventeen rings and a head." Successively these portions, as they become fully developed, detach themselves and start on an independent career, producing new individuals in the same manner.

It is worthy of note that these portions successively detached are without organs for the production of eggs, the last-formed individual forming an exception. Here we find a fact which re-occurs in a modified form among certain insects.

Here, again, we find relations so different from those which prevail among ourselves and our near kindred in the animal world that our common terminology proves misleading. We have called that portion of the *Nais* which includes the original head the "mother," and the portions which develop heads of their own "daughters." But everyone will see that in so doing we are taking liberties with the words. Whatever consciousness such creatures possess—and we have certainly no rational warrant for pronouncing them unconscious—must be common to the entire series up to the date of their separation. Let us suppose a cat reproducing its species in this manner. The question might arise, Which is the Pussy who a couple of months ago jumped upon our work-table and overturned an inkstand? It would be impossible to answer. Yet what would thus puzzle and confound us in a cat is the common order of nature in the *Nais*.

In the higher departments of the animal world, in the Mollusca, Arthropoda, and Vertebrata, we no longer find such distinct evidences of compound existence. Reproduction by budding here no longer occurs, and the individual animal no longer consists of an aggregate of zooids which may lay claim, more or less plausibly, to the rank of independent organisms.

Still the transition from compound or "colonial" to single unitary existence is not made abruptly. Certain reminiscences, if we may so speak, of the earlier multiple life may be traced even in the highest animals.

Suppose we take one of the simpler Annulosa,—say a centipede. We find it composed of a number of segments, or "somites," between which—save the head—and the last abdominal joint there is little difference. Each bears a pair of legs with their necessary muscular apparatus; each has its pair of tracheæ, forming a complete respiratory organ; each contains a nerve-centre, or ganglion, differing relatively little in size and complexity from the brain. So far, then, each "somite," or joint as it is popularly called, possesses many of the characters of an independent being. But none of them, if severed from the rest, is capable of maintaining an independent existence or of surviving for more than a few hours. Reproduction is exclusively effected by means of eggs, secreted by especial organs, and in most cases it requires the concurrence of two individuals of opposite sexes. Budding has ceased, in as far as the production of an entire animal is concerned. At the same time we find a remnant of this mode of reproduction in the power of certain animals to develop new limbs or organs in place of such as have been mutilated or cut off. Thus the newt, if deprived of a leg or tail, can in time replace the missing organ. In snails the eyes, the tentacles, and the lips, if amputated, are completely restored. But the higher we ascend the more does this power of partial reproduction fade away, and in man it plays a very insignificant part indeed.

For all this the generation of certain of the Arthropoda presents us with a phenomenon which closely approximates to reproduction by budding as witnessed in the lowest animals and in plants. We refer of course to parthenogenesis. It has been observed that several kinds of female insects lay fertile eggs without having had connection with a male of their species. This is pre-eminently the case with the

Aphides or plant-lice. The eggs of these pests, after remaining dormant through the winter, give rise to a brood consisting solely of females. These again, in turn, without impregnation, deposit so-called eggs,—more correctly pseud-ova,—from which spring nothing but females. So the process continues through the summer. But in the autumn the last brood consists of both sexes, and the impregnated eggs now produced remain through the winter. If the reader will turn back he will see that this process of reproduction is almost exactly identical with what we have noticed in the *Nais*. There, too, we found a succession of individuals formed by budding, and able to reproduce themselves by budding alone, until the series is finally terminated by an individual capable of producing eggs. The unimpregnated egg, or pseud-ovum, of the *Aphis* is the representative of the bud of the *Nais*. If we adopt the view that all that proceeds from a single egg is an individual animal, then all the descendants of an *Aphis* of the autumn brood form along with it one individual, separate bodily, but connected in their development. Such a succession of Aphides is therefore a compound animal.

Full parthenogenesis does not, so far as has been traced, occur in the Vertebrata, although the unimpregnated egg of several species has been known to undergo the first rudiments of segmentation. This may well be considered as one of those cases of "reversion" which show that the higher animals are sprung from forms in which gemmation, and consequently compound existence, are normal.

Even in the anthropoids, and in man himself, there are facts which point in the direction of a complex personality. The two-headed monstrosities which have been brought into the world, and as a rule hastily dismissed out of it, if carefully observed during life and as carefully dissected after death, would not merely raise, but possibly aid in solving, certain questions which go to the very root of our idea of personality.

A simpler phenomenon of daily occurrence is the presence in man, and as part and parcel of his system, of certain minute organisation—to wit, the white-blooded corpuscles. Many biologists would place these particles on a level with certain of the Protozoa. Thus human life and the life of every higher animal would be complex indeed, including the lives of myriads of microbia. Do they exist for our sake, or we for theirs? These questions are unscientific, but they are on a level with some which are still too frequently asked.

V. ON TECHNICAL EDUCATION.

By ROBERT GALLOWAY, M.R.I.A.

(Continued from vol. iv., page 576.)

IN the last article on Technical Education it was stated that some of the more important differences in the systems of teaching adopted in England and Germany would be compared in some of the following articles on this subject.

We will commence by contrasting the plan that has to be followed in all the schools, with the few exceptions to be presently named, under the Department of Science and Art, with the methods of instruction followed in corresponding educational institutions in Germany.

Payment on results is the centre round which the whole system of teaching in the Department of Science and Art Schools revolves, with the exception of the Science and Art Schools or Colleges at South Kensington and the corresponding ones in Dublin; the reasons assigned for these exceptions, and the plan and management of these exceptional institutions, will be deferred until the necessity for a Minister of Education comes to be considered.

When the present Chairman of Committees of the House of Commons, the Right Hon. Lyon Playfair, was Secretary of Science in the Department, the payment on result system was not the one followed; but shortly after he left it was established in that, and afterwards in the Art, branch. When Government Schools of Art were also first established in England the teachers of Art were paid by salary; afterwards by the certificates of qualification they had obtained; and subsequently the present system—payment on results of instruction as tested by the examination of the students—was substituted for payment by certificates. But the teacher does not receive payment on results for every class of students, but only for those who are in the receipt of weekly wages, and their children; or persons in the receipt of not more than £200 a year, and also their children, and teachers and pupil teachers in some elementary schools.

As payment on results is the centre, as we have already stated, around which the system of instruction under the Department revolves, it is desirable at the outset of our investigation to learn what advantages the Department claims for this over the other two systems of payment that had previously been in operation. The late Sir Henry Cole, in his examination before the Select Committee on Schools of Art, held in 1864, was asked the question. His answer was—"I do not think, as respects the old expenditure, there will be much difference between the one and the other. The advantage of the new system is that you can keep the expenditure more under control; you have only to raise the standard from time to time, and thereby you can keep the total sum under control." In answer to another question, on the same subject, he said—"I think that the new system will call for larger sums than the old system did, but I think the new system has the advantage of being quite under control, because, of course, if the standard be raised there will be less expenditure." He subsequently gave the following remarkable answer,—remarkable it was at the time it was given, and it appears still more remarkable at the present time, when it is all but universally acknowledged that we are still far behind continental countries in scientific and technical education; and in consequence we have sent out Commissions and Sub-commissions all over Europe* to investigate the modes of instruction adopted in the different European countries for teaching these branches of education, in order to try and improve our own. It is pregnant with information as to some of the causes why we are so far behind continental countries in scientific and technical education, after all the vast sums of money that have been spent for their cultivation by the Department of Science and Art.

The question asked—"Will you explain to the Committee more fully the third reason for the introduction of the New Minutes; namely, to bring the general expenditure upon Schools of Art more under control by the greater facility of raising the standard?" Answer:—"Supposing Parliament should say to us, 'Instead of distributing £15,000 amongst Art Schools, you should only distribute £10,000,' *all we* should have to do under the New Minutes would be simply to raise the standard of excellence. If we did so, of course there would be fewer amounts of public money to be given away; therefore that puts the matter *entirely* in the hands of the Department. Let me say that has been exactly the case with the Science Minutes. *I venture to say emphatically they have been a brilliant success.* The success of those Minutes led the Department to see that they might, with judicious qualifications, be made strictly applicable to Art. For instance, last year we found that by the bonuses offered as prizes in the Science Minutes, a master in the northern part of England was earning, upon results, for teaching one class only, mechanical drawing I think, £250. *The Lord President looked about him, and said 'This is a large sum; we must raise the standard a little, and we can reduce it to* £150 or £100'; *it is entirely under control.*"

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* In the last article we noticed some of the Commissions and Sub-commissions that were appointed to visit continental countries for the purpose of inquiring into the methods adopted by the different States for imparting technical instruction. We may here add that the Commission of Technical Instruction have already visited the following countries—France, Germany, Austria, Switzerland, Italy, Holland, and Belgium; and one of the members of that Commission, with the Secretary, has paid a special visit to the Black Forest, in order to collect information with respect to the native home industries of that district. And quite recently the Manchester School Board appointed a deputation to visit specially the Paris schools with a like object.

The Lord President of that day showed the value he placed on a good teacher by a very extraordinary course of proceeding; I rather think our nobility show their appreciation of a good cook or a successful jockey by the reverse method. The standard of excellence, it will be observed, was not to be raised for the purpose of giving the *taught* better instruction, but for the purpose of cutting down the *teacher's* earnings: as one teacher had earned £250, he and all the other teachers of that subject were to suffer pecuniarily for it; one would rather have thought the proper mode of proceeding would have been for the Lord President to have sent some competent educationist to see how this exemplary teacher taught his subject, for this visit might have proved as advantageous to the country as the visits of some of the roving commissions to continental countries,—and to ascertain how many hours a day this excellent teacher gave to his work, for that is a point that Sir Henry never seemed to have considered. Let us for a moment reflect how a commercial establishment would prosper under such a system. We will take the case of a large mercantile establishment where a large number of salesmen are employed, and who are paid solely by the commission they receive on the goods they sell: one of these salesmen so well performs his duty that he earns a fair, but by no means excessive, income; forthwith, on that account, the partners in the concern reduce not only the scale of commission in his case, but in the case of all the other salesmen. How would a mercantile establishment prosper under such a system? Would not every efficient salesman leave, and would they not also advise others not to enter that establishment?

Sir Henry stated, on the same occasion, that their system of teaching drawing was far superior to the systems of all Europe put together: one of the members of the Technical Commission, Dr. Roscoe, has recently stated the very reverse; he says the French system of teaching drawing is superior to ours:—"A little French or German boy out of the street is able to draw, and draw accurately, in a way which is astounding to an Englishman conversant only with the work of the ordinary primary English school."

Sir Henry also said that he thought that when South Kensington was once provided with permanent and safe buildings, the annual Parliamentary grant would not appreciably increase; in fact that was the advantage to be derived from the payment by result system. South Kensington has been provided with permanent and safe buildings, yet the net increase of the grant this year over that of last year is £18,369. Sir Henry did not state what he thought would be effected by the payment on result system in improving the Art and Science education of the country: this is what we purpose examining into, but before commencing we must bring under the notice of our readers three paragraphs taken from the Departments' Science Directory for 1881: we shall number the paragraphs for convenience of reference.

1. "The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and *partial aid or stimulus* towards the founding and maintenance of Science Schools."

2. "*The amount is liable to be decreased, and eventually withdrawn. Payments to teachers, therefore, must not be looked upon as perpetual, or in any way conferring on the teacher a claim to any payments beyond those offered from time to time.*"

3. "*All possible care will be taken by the Department that the Examination papers shall be forwarded in accordance with the applications, and that the results shall be correctly issued. As, however, the number of schools is very large, mistakes may occur. The Department cannot undertake to rectify them, nor will it be responsible for any loss which may thereby occur.*"

It will be seen from par. 3 that if the Examination Papers miscarry no examination will be held, and the teacher will receive no payment or compensation from the Department: he will therefore, as far as the Department is concerned, be deprived of a year's earnings. We learn from par. 2 that a Science teacher under the Department has no certainty of any payment from the Department beyond the present; and he does not even *know* what he may receive for his present work, for it does not depend on the labour and time he has given to his classes. Other teachers who prepare pupils for examinations get paid whether pupils succeed or not; but the Science teacher has to depend for the payment *he may receive from the Department, not solely* on the marks *the examiner* may give, as there are exceptional rules which exclude the teacher receiving payment on results in not a few cases. Uncertainty in the *duration* of an employment, and uncertainty as to the *amount* to be received for the labour and time that has been given, must ever act unfavourably in securing the best talent.

VI. THE METEOROLOGY OF SHAKSPERE.

WE may safely assume that Englishmen in the olden time, like their sons in these days, took much interest in the weather. They discussed the influence of the past portions of a season, the effects of the present showers or sunshine, and the good or evil signs for the coming day, month, or year. For this they had even stronger inducements than ourselves. A wet harvest time might bring the perils of actual famine home not merely to scattered individuals, but to entire districts. Further, the weather and its signs were looked on in what we should regard as a superstitious light. Unusual seasons over and above their own unpleasantness were held to forebode foreign wars or civil tumults, pestilence, and other calamities. It may be, therefore, not uninteresting to glance at the weather-lore of our forefathers, and ask in how far their rules for a foreknowledge of the season were well founded. For connecting this subject with the name of Shakspere we have good reason. We have no certainty as touching the scraps and jingles in which popular meteorology is embodied. They may be old as the hills, or they may date no further back than the last century, and may have been blended with the results of modern investigation. But for the passages on this subject which we find here and there in the writings of Shakspere we have a minimum limit. They must represent the traditions current in the days of his youth, and which had been handed down for at least a couple of generations. They must have arisen in an age when the barometer, the thermometer, and all other meteorological instruments were still unknown.

The first point we notice is that the south wind is held in strange disrespect. It is regarded as unhealthy, as boisterous and wet, and as especially connected with fog. Thus we read—

"All the contagions of the south light on you."
Coriolanus, I., 8.

"A south-west blow on ye
And blister you all o'er!"
Tempest, I., 4.

Elsewhere we find—

"The south fog rot thee!"

And again—

"Like foggy south puffing with wind and rain."

In short this wind is never well spoken of by Shakspere, except in one passage:—

—— "Like the sweet south
That breathes upon a bank of violets,
Stealing and giving odour."
Twelfth Night, I., 1.

So exceptional are these lines to all other references to the south wind that in Knight's Cabinet Edition an emendment is proposed. The editor would read "sound" for "south."

It is scarcely necessary to say that this emendation involves greater difficulties than the one it is intended to remove. Shakspere assuredly would never have likened a strain of music to a "sound," nor spoken of a sound carrying along with it the odours of the violets.

But how comes the poet to couple the south wind with fogs? We know that fogs are exclusively connected with the "polar current," *i.e.*, northerly or easterly winds, though of course so gentle as to be only just perceptible. The moment the wind turns to the south or south-west London breathes afresh, and finds that the threatened doom of the great city is not yet.

Besides one of the passages quoted is self-contradictory. "Foggy south puffing with wind and rain!" Puffing wind and rain, from whatever quarter, dispel a fog.

Nor are the charges of unhealthiness brought against the south much better founded. The south-west wind, especially, blowing as it does over a wide expanse of ocean, is exceedingly unlikely ever to have wafted any pestilence to the shores of England. We think of the proverb still current in Yorkshire and Lincolnshire :—

"When the wind is in the west
The weather is the best;
When the wind is in the east
It's neither good for man nor beast."

It is still possible that as fens and marshes were much more abundant in the Elizabethan age than they are now, and that as the south wind is generally accompanied by warm weather, malaria may have been more common in times of southerly winds than when the weather was colder. But in all other respects we cannot do other than pronounce the epithets which Shakspere applies to the south wind grossly libellous, and the traditions upon which they are founded instances of loose observation. We should, indeed, be glad to escape coming to this unfavourable conclusion; for our great poet, though his attention was mainly fixed upon human passion and human character, had yet a keen eye for external Nature, as we shall show below. The Ancient Britons are said to have applied the name "cloudy or misty sea" to the German Ocean, from the fact that winds blowing from that quarter were apt to bring fog and gloom. But if the south wind was little admired in the Elizabethan days, the northern wind fared no better. Shakspere would not have committed himself by writing an ode like that perpetrated by Kingsley. The longing which some people in these days profess for a good old-fashioned winter, and the opinion of the "bracing" character of a north-easter, are, we suspect, notions of somewhat modern origin, and are often chimney-corner aspirations, about as real as Jamie Thompson's praises of early rising. Shakspere shows no love for winter :—

"You and you are sure together
As the winter to foul weather."
As You Like It, V., 7.

It is only luxurious ages and persons who can expose themselves to the weather only when and how they like, and come in to a comfortable home when sufficiently "braced," who can like winter.

The opinion is often expressed that the climate of these islands, and indeed of Western Europe altogether, has undergone a change for the worse during the last two or three centuries. Even if our average temperature has not decreased, or our mean rainfall—or rather number of wet days—been augmented, we have, men say, a less prospect of warmth, and dryness, and calm coming when they are wanted,—that is, from the blooming of the wheat to the ingathering of the various crops. True, we have had, since 1870, great store of unseasonable weather, among which 1879 holds a memorably evil pre-eminence. But let us listen to the following passage :—

> " Therefore the winds, piping to us in vain,
> As in revenge, have sucked up from the sea
> Contagious fogs ; which falling on the land
> Have every pelting river made so proud
> That they have overborn their continents ;
> The ox hath therefore stretched his yoke in vain,
> The ploughman lost his sweat, and the green corn
> Hath rotted ere its youth attained a beard.
> The fold stands empty in the drowned field,
> And crows are fatted with the murrain flock.
> The nine-men's morris is filled up with mud,
> And the quaint mazes in the wanton green,
> For lack of tread are undistinguishable.
> The human mortals want their winter cheer,
> No night is now with hymn or carol blest ;
> Therefore the moon, the governess of floods,
> Pale in her anger washes all the air
> That rheumatick diseases do abound.
> And thorough this distemperature we see
> The seasons alter ; hoary-headed frosts
> Fall in the fresh lap of the crimson rose ;
> And on old Hyem's chin and icy crown
> An od'rous chaplet of sweet summer buds
> Is as in mockery set. The spring, the summer,
> The chiding autumn, angry winter change
> Their wonted liveries, and th' amazed world,
> By their inverse now knows not which is which."
>
> *Midsummer Night's Dream,* Act II., Sc. 2.

Is this a mere imaginary description ? We should say that it is a most faithful picture of such a season as that of 1879, with all its distressing features. We have summer frosts, short fits of mild weather coming when cold would be more seasonable, overflowing rivers, fields swamped, sheep perishing of foot-rot and of " flukes " in the liver, the corn rotting before it can reach maturity, the field-paths becoming indistinguishable because impassable. It is, in short, 1879 to the life, as any faithful observer—especially if living in a rural district—would have found it, and no one could have given its sad characters at once so strikingly and yet so briefly. We see, then, that cold wet summers are not a misfortune peculiar to the nineteenth century. A glacial epoch may be returning, but " cruel 1879 " is no proof that such is to be the doom of our immediate posterity.

The appearance of the sky at sun-rising has always been considered an indication of the weather that is to follow. Proverbs in common use in France and Germany, as well as in Britain, warn us against a red sky in the morning. Shakspere was no stranger to this view, which does not always hold good.

> "As doth the blushing discontented sun
> From out the fiery portal of the east,
> When he perceives the envious clouds are bent
> To dim his glory, and to stain the tract
> Of his bright passage to the occident."
> *Richard II.*, Act III., Sc. 6.

Here we have a picture of a particular type of unpromising morning, which every observer of the weather must have observed, and which was but too common both in 1879 and in 1882. The sun rises "blushing"—*i.e.*, red—into a tract of clear, fiery sky, beyond which lies a dense bank of clouds, which maintain their position and thicken till the whole sky is overcast, and the rain sets in.

Another red dawn is described, as on the day of the battle of Shrewsbury:—

> "How bloodily the sun begins to peer
> Above yon busky hill! The day looks pale
> At his distemperature.
> The southern wind
> Doth play the trumpet to his purposes,
> And by his hollow whistling in the leaves
> Foretells a tempest and a blust'ring day."
> *Henry IV.*, *Part I.*, Act V., Sc. 1.

Here, in addition to a red dawn, we have another indication of rain drawn from the peculiar character of the wind. In various rural districts we have heard a "bustling wind" spoken of as a sure sign of rain, and, as far as our observations have gone, it has invariably proved correct. This wind is by no means violent; it does not seem to move the stems or the larger branches of trees or shrubs, but it causes a great commotion in the leaves, especially if these are broad.

It is, perhaps, curious that in the writings of Shakspere we find no reference to the sunset as an augury for the day to come. Nor is the rainbow mentioned, concerning the signification of which there exist not a few contradictory proverbs. All, we think, agree that a rainbow in the morning is a bad sign. But the English countryman is apt to regard—

> "A rainbow at night
> As the shepherd's delight."

The French peasant, on the contrary, says, more wisely as we think,—

> "Arc en ciel du soir
> Il faut voir."

Certainly in settled fair weather rainbows, either at morning or night, are not likely to make their appearance.

The cry of the owl seems to have been held as characteristic of stormy weather:—

> "The obscure bird
> Clamoured the live-long night."
> *Macbeth*, Act II., Sc. 5.

It may be doubted whether this circumstance is mentioned as characteristic of stormy weather, or as an omen that mischief of other kinds was about. We have never met with any popular saying which connected the voice of the owl with rain and storm, nor have we observed it to be a "weather-wise" bird. The notion that its hooting is a sign of death has been common for centuries. Some wise man attempted to explain this supposed fact by the assumption that the owl smells the approach of death in a sick man, and flutters screaming round his house in an effort to get at the body. This is a curious collection of blunders. The owl prefers, like a true sportsman, to kill game for its own dinner, and does not care for a prey which has died a natural death. Secondly, the bird has by no means a very acute sense of smell, and would be utterly unable to detect the odour of a dead or dying man outside the house. She is very possibly attracted by a light in the sick chamber, and puzzled thereby, as are sea-fowl by a lighthouse, flutters around instead of attending to her lawful business.

The notion of the unwholesomeness of the night air must have been already current in Shakspere's time. We read—

> "To dare the vile contagion of the night,
> And tempt the rheumy and unpurged air."
> *Julius Cæsar*, Act III., Sc. 3.

It is indisputable that in malarious districts the night air is especially dangerous. But it may well be doubted if the extreme dread of the night air common in England is anything more than a superstition. There are many people who—whatever may be the temperature, and how dry and calm soever the weather—would be horrified at sleeping with their bed-room windows open. It has happened to us more than once, when on a visit at a friend's house, to find that during dinner the servants had carefully shut the windows, and thus secured—for us at least—the luxury of a restless night. Perhaps in Shakspere's day malaria might have been more common than in the present time, and to shun the night air was therefore good policy. There are even yet districts in England where we should not prefer to sleep with open windows in an autumn night.

To conclude these somewhat random remarks we will quote a very faithful description of the hush which often precedes a storm :—

"But as we often see against some storm
A silence in the heavens, the rack stand still,
The bold winds speechless, and the orb below
As hush as death; anon the dreadful thunder
Doth rend the region."

Hamlet, Act II., Sc. 7.

This passage, like the account of the wet season which we cited above, is evidently the fruit of personal observation, and not of tradition.

ANALYSES OF BOOKS.

Siberia in Asia: a Visit to the Valley of the Yenesay in East Siberia, with Description of the Natural History, Migration of Birds, &c. By HENRY SEEBOHM. London: John Murray.

SOME time ago we had the pleasure of examining Mr. Seebohm's "Siberia in Europe," and we are glad to find that the work before us is fully equal in interest to its companion volume. With the same main object in view—the investigation of the geographical distribution of birds, and of the variations caused by locality—the author has explored Siberia proper as far as the Valley of the Yenesay, and made a number of most important observations. Nothing can better show the difference in spirit between the Old and the New Natural History than the manner in which he has carried out these explorations. An ornithologist of the year 1776 who had gone over the same ground would have simply presented us with an inventory of species to be found in certain localites; he would have duly indexed all forms he saw differing from their nearest West European allies as "new species," or else have overlooked their peculiarities altogether; and the question why and how they differ, if it ever entered his mind, would have been suppressed.

But the book is not entirely filled with bird-lore. We meet with valuable facts anent the topography, the resources, and the climate of the regions traversed, and on the peculiarities of their inhabitants.

In the neighbourhood of Omsk Mr. Seebohm remarked that some of the villages were exclusively Russian, whilst others had a Tartar, and consequently Mohammedan, population. He notes that "the cross was too often the symbol of drunkenness, disorder, dilapidation, and comparative poverty, whilst the crescent was almost invariably the sign of sobriety, order, enterprise, and prosperity. At Omsk he saw, in the museum formed by Prof. Slofftzoff several birds which have not been recorded east of the Urals, such as the blackcap, the garden warbler, and the Icterine tree-warbler. He adds, however, in comment, that the specimens bore no special labels to authenticate the localities, so that the fact of their having been shot near Omsk must be accepted with hesitation.

At Yenesaisk Mr. Seebohm met with the first indication of interbreeding between the carrion crow and the hoodie. About 75 per cent of the crows in that district are thorough-bred carrions, perhaps 5 per cent pure hoodies, and the remaining 20 per cent are hybrids of every stage between the two. He met with similar cases of hybridism in not a few other places. He found hybrid birds mated together, and producing eggs and young. The evidence of the fertility of these hybrids is thoroughly conclusive. Surely nothing more will be needed to uproot the old superstition—we can give it no better name—of the universal sterility of half-breeds. Hybrids between the capercailzie and the black grouse appear also to exist. In Central Europe the male capercailzie has frequently been found mated with the female hazel grouse.

In the Valley of the Yenesay Mr. Seebohm obtained two specimens of Pallas's house martin (*Hirundo lagopoda*), a species nearly allied to the common house martin, which breeds in Eastern Siberia and appears to winter in Borneo. In England it is so rare that the British Museum did not possess a specimen.

Mr. Seebohm's opinion of the Russian character is not too flattering. He writes:—The Russian official is very impartial in the selection of his victims. He plunders the Government, he plunders the people, and he plunders his fellow-officials; but his worst feature is that he helps the rich to plunder the poor. A merchant does not lose caste by doing a dishonourable act. So far from feeling any sense of shame from having acted dishonourably, he feels a sense of complacency. It gives a Russian far more innate pleasure to cheat somebody out of a rouble than to earn a rouble honestly. He feels that he has done a *clever* thing by earning a rouble dishonestly, and he despises the honest man as *weak*."

But this general absence of truthfulness and honour our author accounts for not by considerations of race, but of government. Yet he seems to us to damage his own contention by admitting that the "Turk never lies," though labouring under a still worse government than that of his northern neighbour.

But Mr. Seebohm, though he tells the truth concerning Russia, is not blind to evils nearer home. He writes:—"The uneducated Russian is a child, with a child's virtues and a child's faults. The uneducated Englishman is a brute, a savage, with nothing of the child about him."

In his Preface the author speaks of Siberia as "a magnificent country of superb forests and corn-fields, capable of rivalling those of Minnesota, whilst its mineral wealth includes iron equal in quality to that of Sweden, and gold almost as abundant as that of California, to say nothing of copper, salt, and coal. Siberia is in fact a second Canada in reserve, and the political geographer—looking into the far future, and wondering what is to become of the surplus population and capital of the English and Teutonic races when North America shall be as thickly populated as Europe—may postpone his anxiety for many centuries to allow time for the civilisation of Siberia to re-open the problem."

It is scarcely needful to add that before Siberia can become a field of emigration for the people of these islands an event must have taken place which, according to our author, the Siberians eagerly desire. "Some day, doubtless, this city (Irkutsk) will be a second New York, the capital of an Asiatic United States, a free Siberia from the Ural to the Pacific. Every Siberian imbibes the notion of freedom with his mother's milk. Though born in Russia, or the child of Russian parents, he repudiates his nationality, calls himself a Siberiak, and is proud of his country."

Differing from the "Anglo-Saxon"—whether of Britain or America—in a number of points, the Russian agrees with him in his propensity to sect-forming. Mr. Seebohm had an opportunity of visiting the village of Toer-o-Kansk, the seat, or rather place of banishment, of one of the strangest of these sects. It is described as a model village, "without crime, where idleness and drunkenness were unknown. Yet the people did not look happy. There was no fire in their glance, no elasticity in their step; there seemed to be no blood in their veins. It was the village of the Scopsee, a sect whose religion has taken an ultra-ascetic form. All the men were castrated, and in all the women the milk-glands were extracted from the breasts. They ate no animal food except fish, and did not even allow themselves butter or milk. Spirits, wine, tea, and coffee were prohibited. Although the population of the village numbered under a score, yet there were two sects of Scopsee among them; one drank milk and the other did not." We think it may safely be said that no such community could have arisen among a French, Spanish, Italian, German, or Scandinavian people.

Passing to a subject which for us has a more special interest, we note the author's remarks on the migration of birds. In his former work he gave some interesting observations made at Heligoland. He has since then carried on his investigations during an autumn and a spring in the South of France, and his conclusions have in consequence been somewhat modified. He says, in the work before us, "The marked difference between migration at Heligoland and migration on the shores of the Bay of Biscay is, that in the former locality not a bird was to be seen in unfavourable weather, but that when the wind was propitious birds came over with a rush." At the Bay of Biscay, on the contrary, "a gentle stream of migration seemed always to be going on, in almost all weathers, from early morn till late at night." Hence he infers that during a long land journey birds travel more slowly in unfavourable weather, and rest at night, but if they have to cross the sea they wait for suitable wind and weather.

Our author retracts his former doubts concerning the great routes of migration. Excursions of a few miles inland "took him out of the range of migration." On the west coast of

France he found that birds "appear to migrate low, principally by day, and to follow the coast-line." He now concedes that birds, in crossing the sea, "follow ancient coast-lines." There is no doubt that birds flying northwards in France would find the coasts of the Bay of Biscay an excellent guide. Nor can we wonder that those which cross the Channel should take the "short sea route" from Calais to Dover. Hence it is not surprising if certain migratory species are more common in the south-eastern counties of England than in the south-west. It remains to be traced what birds of passage, if any, cross over direct from the Continent to Ireland, and which pass by way of England. The migration *viâ* Italy and Germany, and those through Greece to Hungary, and by way of the Dardanelles to Bulgaria and Rumania, have still to be studied. The contingent for Illyria, Hungary, &c., certainly seems to follow the Dalmatian coast. He considers that the origin of migration does not probably date back to before the Glacial epoch. "The more one sees of migration the less it looks like an instinct which never errs, and the more it seems to be guided by a more or less developed reasoning faculty which is generally right, but occasionally wrong." The whole of this chapter will well repay a most careful study both on the part of the observer and of the philosophical zoologist.

The ornithological results of Mr. Seebohm's expedition, though somewhat lessened by various mishaps, especially by two shipwrecks, which, as he drily observes, "did not form a part of my original programme," were still numerous and important. He complains of the manner in which Pallas, the pioneer of Siberian ornithology, has been treated by systematists. That able explorer found many species of Siberian birds closely allied to West European species, but still distinguishable. To such forms he gave names, and to those names modern writers have shown scant justice. "In some cases, where they have had an opportunity of comparing examples from Siberia with West European skins, they have admitted the validity of his species; but in other cases, where they have also had access to East European skins, the existence of intermediate forms has been alleged as a reason for denying the validity of the species, and the Siberian forms have been passed by with a contemptuous sneer, as beneath the dignity of Science. In the majority of cases, however, the writers have never seen a Siberian skin, and Pallas's name is consigned to the limbo of synonyms without note or comment. With these writers a form is either a species or it is nothing. They attempt to draw a hard and fast line where Nature has drawn none. They profess to believe in the theory of the development of species, but they never dream of looking at birds from an evolutionary point of view. In their hearts they still cling to the old-fashioned notion of special creation." This is very just criticism. The author backs up his opinions by giving instances of a series of forms, one extreme term of which may occur in southern or western Europe. Thus in the marsh tit "English skins are the brownest, and have the black on the head extending only to the nape, and are scarcely distinguishable from examples of *Parus palustris* from the South of France, Italy, and Asia Minor. Examples from Norway differ in having the back grey instead of brown. Examples from Archangel are greyer still, and have the black on the head extending beyond the nape. Both these characteristics are more pronounced in skins from the Petchkora, the Obh, and the Lower Yenesay, and still more in those from the Upper Yenesay."

After giving further instances the author returns to the charge at the very conclusion of his book. He writes:—"The confirmed habit of the older ornithologists, of either treating these little differences as specific or of ignoring them altogether, is much to be deplored. I venture to suggest, as a punishment for their delinquencies, that they should be exiled to Siberia for a summer to learn to harmonise their system of nomenclature with the facts of Nature. Dr. Dryasdust and Professor Redtape have committed themselves in the pre-Darwinian dark ages to a binomial system of nomenclature which does not easily lend itself to the discrimination of sub-specific forms; and although the American ornithologists have emancipated themselves from the fetters of an antiquated system, English ornithological nomenclators still groan under the bonds of this *effete* binomial system, and vex the souls of field naturalists with capricious change of names in their futile efforts to make their nomenclature subservient to a Utopian set of rules called the Stricklandian code—laws which are far more honoured in the breach than in the observance, and have done great harm to the true study of birds. It is devoutly to be wished that the rising generation of ornithologists would have the courage to throw the binomial system to the dogs, and trample the Stricklandian code under foot, and once for all study Nature and make their nomenclature harmonise with the facts of Nature."

These strictures carry the more weight because corresponding complaints are made, *e.g.*, by entomologists. May we not ask whether the very concept of "species," as still used, does not require serious modification, or, rather, whether the term itself should not be superseded as fraught with misleading reminiscences? In any way we must hold that Evolutionism is useless —worse than useless—if held in theory and ignored in practice. If it is an error, the more we try to apply its principles in our studies of Nature the sooner we shall become aware of the fact. If, as we believe, it is a great truth, we have no right to let it lie idle. It is not pleasant to see that here, in the native country of Darwin, the great reform which he inaugurated is less advanced than it is abroad.

Of Mr. Seebohm's work, as entertaining for the general reader and suggestive for the naturalist, we cannot speak too highly.

Anatomical Technology as applied to the Domestic Cat. An Introduction to Human, Veterinary, and Comparative Anatomy. By Burt G. Wilder, B.S., M.D., and Simon H. Gage, B.S. New York and Chicago: A. S. Barnes and Co.

In order to form a just estimate of the work before us it is necessary to dissociate as completely as possible its matter and its manner,—the facts which the authors undertake to teach, and the strange language which they have seen fit to adopt.

The value of the treatise from the former point of view is indisputable. The reasons given by the authors for selecting the domestic cat as the especial subject upon which a practical knowledge of mammalian anatomy may best be acquired are perfectly sound. The cat, as they remark, is comparable with the domestic animals upon the one hand, and with man, through the monkeys, upon the other. Another advantage is that the cat is less subject to variation than most other animals which are otherwise accessible, so that an observation made upon one cat will substantially apply to all other cats. With the dog, which is about equally procurable, this freedom from variation does not obtain, the differences in the brain of various breeds being considerable, and not as yet fully worked out.

Passing over the Introduction as containing no little matter which must be discussed separately, we come to the first chapter. Here the author gives a descriptive catalogue of the instruments and materials used in dissection, their uses, and preservation. There are, also, instruction for killing the subjects, precautions for cleanliness, comfort, and health, and notes on the treatment of wounds received during dissection. This chapter is admirably written, and in some respects reminds us of the instructions in Faraday's "Chemical Manipulations." Of course one feature of this chapter—the lists of prices and the names of makers and dealers—is exclusively designed for use in America. Some of the prices seem to us very high; *e.g.*, 20 dollars for a tripod dissecting microscope.

In Chapter II. the authors proceed to a general description of the skeleton, and to the "anatomical landmarks."

Chapter III. is devoted to a very carefully written account of the preparation and preservation of anatomical specimens. As an instance of the attention to minute details which characterises the work, the authors give instructions for obtaining alcohol free of duty for scientific purposes, under a particular law of the United States. The cost of alcohol so obtained is only one-sixth of the retail price, but the formalities to be gone through are serious.

The fourth chapter deals with coarse injections. The fifth and sixth chapters treat successively of the bones and the muscles; the seventh is taken up with an account of the abdominal and thoracic viscera, whilst the eighth is devoted to the circulatory system.

In the eighth chapter we have an account of the nerves, and in the ninth of the brain. Here the authors introduce an account of the Amphibian brain to be studied in the frog,—that general "martyr of Science," as he has been called. Instructions are given for rapidly and painlessly killing these animals, which students might otherwise find no easy task. A comparison between the brains of the frog and of the cat is then instituted. The following recommendations for research are given:—"Numerous and careful preparations and drawings should be made of the brains of all Carnivora and monkeys, especially the young. The same should be done for peculiar fœtal and adult human brains. Between the ordinary Carnivora and the monkeys are two groups whose brains should be studied with especial care: the seals have a rudimentary post-cornu and occipital lobe, and these parts are said to be well developed in the lemurs, which have affinities with both the Carnivora and the Primates." It need scarcely be added that such researches are no less needed from a psychological than from a morphological point of view.

The eleventh chapter finally deals with the cranial nerves and the organs of sensation. There is also an Appendix, and a somewhat elaborate Bibliography.

So far we have felt great pleasure in examining this work. The authors are masters of their subject, and are earnestly desirous to explain every detail to the student, and to put him in the right track for conducting original research, which should be, in our opinion, the main object in the pursuit of Science.

The work has, however, another phase which to us is less satisfactory. The authors are anxious to introduce a new nomenclature, in which many intelligible and simple terms are to be replaced by new-coined Græco-Latinisms. The very title of the book, "Anatomical Technology," is a departure from common usage, and is therefore liable to be misunderstood. Under "Technology" the world understands the scientific principles of some trade, manufacture, or industrial art. Had we merely seen this book announced, without a sketch of the contents, we should not have had the slightest conception of its nature. We should have preferred some such title as "Anatomical Manipulations," or "Guide to Anatomical Practice."

As regards the new terminology, we think nothing can be a greater mistake than the multiplication of technical terms, especially in any portion of Biology. The great educational advantage of the Natural Sciences, as compared with Classical Studies, is that they draw off the attention from words to fasten it upon things. By the reckless multiplication of technicalities this advantage is more and more forfeited. But there is, as it appears to us, a further sin in Dr. Wilder's reformed nomenclature. Now that an increased and increasing number of persons, who are unacquainted with the classical languages, are studying Biology, it seems strange indeed to make its technical language more and more unintelligible to all who are not classical scholars. It must further be remembered that no scientific terminology can become cosmopolitan. The German *savants,* following the lead of our old master Oken, are more and more discarding Græco-Latinisms. The French so modify their classical terminology that it becomes difficult of recognition. With the names of animal or vegetable species the case is different. As a rule they are to the man of Science mere labels by which to identify any particular species. As definitions or descriptions they are worthless. What, for instance, do we learn concerning the extinct *Moa* by giving it the name *Dinornis?* Neither its locality, its habits, nor its place among birds. The generic name *Moa*, being shorter, more euphonious, and not being the property of any civilised nation, is in every way peferable. From the names of the parts of animals we expect merely that they should be correct guides to identification. If this cannot be done for English speaking nations by means of English words, then, and not till then, it will be time to look elsewhere. But what gain in clearness, precision, convenience, there can be in saying *arthra* instead of joints, *dextral* and *sinistral* instead of right and left, &c., we must confess ourselves unable to see.

Longman's Magazine. No. 2, December, 1882. London: Longmans and Co.

As in the case of its predecessor a very considerable portion of this number falls outside our cognizance. "John Harrison, the Chronometer-Maker," tells us the old sad story of a meritorious and successful inventor whom the Government of the day strove in every possible manner to defraud of the reward he had fairly won.

"The Earth in Meteoric Shadow," by R. A. Proctor, is an exceedingly probable explanation of the spells of cold weather which occur with almost absolute regularity at certain times of the year. The most striking of these is the time from the 9th or 10th to the 14th of May. These days seem to have the especial mission of destroying our fruit-crops. These bad spells are traced both in the eastern and the western continents, and in the southern as well as in the northern hemisphere,—a circumstance which in itself is almost conclusive that the cause is of a cosmic order. Mr. Proctor's hypothesis is that at these times a considerable portion of the solar radiations is intercepted by a belt of meteors passing between the earth and the sun, though not, as some have supposed, the meteors which make so striking a display in August and November.

Mr. Proctor's paper contains certain incisive references to his brother astronomers. He remarks that "Even so late as 1879 M. de Fonvielle, editor of 'La Nature,' presented it not as a doubtful theory, but (after the manner which is characteristic, and I cannot but think a characteristic defect, of French popular science-teaching) as a known fact, which his readers were to accept because he said it—*Je vous le dit*, Moi." This charge is by no means unfounded. Again, Mr. Proctor, referring to M. Guillemin and Mr. Lockyer (the editor of 'Nature'), says, "Yet here are two professed teachers of the general public—rather condescending teachers too—not only describe this impossible movement, but even endeavour to picture it."

"The Norway Fjords" is the title of a pleasantly written account of a ten-weeks' trip to the Norwegian coast, by Mr. J. A. Froude. As a matter of course we find here little in the way of scientific observation, but for all this there are passages well worthy our notice. The author tells us that his friend and travelling companion X. "was a sportsman, but a sportsman only as subsidiary to more rational occupations. He was going to Norway to catch Salmonidæ; not, however, to catch them only, but to study the varieties of that most complicated order of fish." We have here a rather strong admission on the part of a sportsman and a defender of sport! Mr. Froude notices concerning the people of Bergen that "For politics they care nothing, not supposing that on this road is any kind of salvation for them." They are wise; such an atmosphere would prove speedily fatal to our English speech-makers and ochlogogues. The author speaks of the "cleanness" of the houses, not noticing, perhaps, that the Norwegian spits more promiscuously than ever did the American. Had he gone onwards to the Loffodens, however, he would have found squalor such as is unknown in England.

The following passage is worth quoting as a proof of that old but still neglected truth—the impossibility of getting all men to think and feel alike. Says Mr. Froude:—"For lakes and mountains, however beautiful, the appetite becomes soon satiated. They please, but they cease to excite; and there is something artificial in the modern enthusiasm for landscapes. Velasquez or Rubens could appreciate a fine effect of scenery as well as Turner or Stansfield; but with them it was a framework, subordinate to some human interest in the centre of the picture. I suppose it is because man in these democratic days has for a time ceased to touch the imagination that our poets and artists are driven back upon rocks and rivers, and trees and skies; but the eclipse can only be temporary, and I confess, for myself, that, sublime as the fjords were, the saw-mills and farm-houses and fishing-boats, and the patient industrious people wresting a wholesome living out of that stern environment, affected me very much more nearly."

It would be idle to question if Mr. Froude really feels what he here says, but how he or anyone *can* feel thus is to us an insoluble problem. The modern enthusiasm for landscape seems to us perfectly natural, and rather a sun-rise than an eclipse. That in these days man has ceased to touch the imagination is because we live in an age of great dingy cities,—an age of over-population, of worry and bustle, from which solitude—broken only by the presence of intelligent friends—is a heavenly relief.

"The Ghost" and the "Lady's Walk" are striking proofs of a change in public taste. Forty years ago such productions would have been laughed out of countenance.

Hydrostatics, or Practical Mechanics. Part II. By J. T. BOTTOMLEY, F.R.S.E., F.C.S., &c. London and Glasgow: W. Collins, Sons, and Co., Limited.

THE work before us forms one volume of "Collins's Science Series," and is intended as a sequel to the "Elementary Dynamics," by the same author. It is observed in the Preface that the two books follow closely the programme prescribed by the Science and Art Department for the subject of elementary theoretical mechanics, in which they form a complete course. Mr. Bottomley, however, has not absolutely confined himself to the subjects specified in the Directory of the Science and Art Department. He has included a consideration of Thermometry, and has given explanations on the height of the heterogeneous atmosphere, and an investigation of barometric formulæ. Finally come a body of questions, a considerable number of which, we are told, are "taken from recent Examination Papers of the Science and Art Department."

The author expresses himself with great clearness, and has given numerous well-executed cuts in illustration.

In making use of Chapter IX., which treats of the "height of the homogeneous atmosphere," the student may possibly be disposed to ask if the atmosphere at the height of 26,217 feet ceases to be homogeneous, and, if so, what is its composition at greater altitude? As far as we have been able to discover he will not find any reply to his question.

The author advocates the metric system of weights and measures in contrast to the British standards. But if, instead of the cubic inch, he would take the grain measure as a unit of volume, he would surely find the inconveniences of which he complains much reduced.

As exceptions to the rule that bodies expand uniformly as their temperature rises, and contract as it falls, Mr. Bottomley mentions water, and perhaps iron and bismuth. One other body at least may be added. Pure tin in the solid state floats upon melted tin just as ice does upon water, and the same is said, though with some degree of uncertainty, concerning zinc.

Among the questions we note one which may mislead or puzzle. On p. 140, No. 41, we read:—"A nugget weighs 45 grms. Its specific gravity is 5·87; that of the quartz is 6·49. How much gold does it contain? The specific gravity here ascribed to quartz must be either a clerical or a typographical error.

The Field Naturalist and Scientific Student. Nos. 6 and 7, November and December, 1882. Manchester: Abel Heywood and Son.

THESE two numbers contain a good store of interesting matter. In an extract from a work by Mr. J. A. Froude, here quoted, we find a strange statement concerning the violent thunderstorms of South Africa:—"To a white man, they say, there is no danger while he has a black at his side, the latter being the better conductor. When one is struck another must be immediately substituted."

Mr. P. Percival communicates a paper on the Devil's Coach-Horse (*Gœrius olens*), but he does not notice the good service which it renders to man by its raids upon earwigs, and by an occasional in-door visit in search of cockroaches and crickets.

Mr. Cuthbert Oxendale gives a description of a "Lancashire Gullery" on Pilling Moss, near Garstang, where about ten to twelve thousand of the black-headed gull (*Larus ridibundus*) live and increase under the protection of Lord Winmarleigh and Captain Bird, the owners of the adjoining estates. Well do they deserve protection, for they clear the fields of larvæ, &c., for miles around.

There is an interesting note on the intelligence of cats, taken from the "Manchester Guardian." The writer very justly says that this animal shows "a power which can only be distinguished from reason by a process of verbal refining which is almost puerile.

A Mr. Brierley, in reply to a question put by a "North Lincolnshire Vicar," states that he never heard of a robin being killed by its own young.

Hylo-Idealism, or the Egoistic Theory of Mind and Matter. By R. LEWINS, M.D.

OUR attention has been called to the above paper, which appears in the "Secular Review," especially as it is a kind of summing up of ideas which first appeared in our pages under the title "Hylo-Phenomenonalism the Summa Scientiæ." The author's views, as here expressed, border very closely upon those of the mediæval nominalists, Abelard and Occam, the difference being simply the outcome of the advances made in Science since the thirteenth century.

Dr. Lewins hopes that his views may ultimately prove an Eirenicon, reconciling the scientific and the poetic interpretations of Nature, and finally eliminating all ontological tendencies. However this may be, it cannot be other than wholesome for the public to be reminded of the assumption underlying all Science. We know that our sensations of colour, form, sound, odour, &c., are merely impressions, *i.e.*, changes in our own mind. We postulate these changes as due to and as corresponding with the existence and the changes in an external world. But both in scientific research and in the practice of daily life we forget too often that all this is an assumption which—be it truth or error—is incapable of demonstration.

Was John Bunyan a Gipsy? By JAMES SIMSON. New York: James Miller. Edinburgh: Maclachlan and Stewart.

WE received some time ago a pamphlet by the same author, on the same subject, and pronounced it as entirely outside our competence. We can merely repeat that the nationality of John Bunyan does not concern the "Journal of Science."

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

EXAMINERS AND THEIR SHORTCOMINGS.

To the Editor of the Journal of Science.

Sir,—You have lately given the world some interesting information on the methods employed by "coaches" in preparing their men. Perhaps you will grant me a corner of your space to communicate, from my own experience and that of my late fellow-students, some facts concerning examiners. I find that wherever the examination is *viva voce*, and where a single student is called up at a time, success or failure very much turns on chance.

Suppose the examiner knows the candidate or his family, he will often chat with him on indifferent matters, and then just put a few questions in a perfunctory sort of way. If a candidate has been up before, and been plucked, the examiner is always doubly severe. I was asked by each examiner in turn "Have you been up before?"

Sometimes an examiner takes a dislike to the looks of a candidate, and treats him to the hardest and most unreasonable questions he can select.

Some examiners, most unfairly and unjustly, try to unnerve and bewilder a student. On receiving a right answer they will put on a look of contemptuous surprise, and in various ways bully and insult their victim. In this manner they find pretexts for rejecting the timid and the hot-tempered, whatever may be their talents and attainments.

I think it will be admitted by all right-minded men that if our present examination system is to continue it should be administered with absolute fairness and impartiality.

I had nearly forgotten that in case of lady candidates there is a display of effusive gallantry, and every point is stretched to "pass" them. I know well that many students unquestionably my superiors have been rejected, whilst I have the good fortune to subscribe myself—

"One who has Passed."

[We shall be very happy to hear further details from this correspondent.—Ed. J. S.]

THE FOG QUESTION.

To the Editor of the Journal of Science.

Sir,—In an otherwise able article on the fog-nuisance I was surprised and shocked to read the following sentence:—"The vast majority continue, with mingled stupidity and selfishness, to build up fires of bituminous coal, and as the law compels factories, but not householders, to consume their own smoke, few houses fail to contribute something to the vast pall which perpetually hangs over London." Surely the writer of the article knows, or might know, that at least two-thirds of the householders of London cannot raise the money which the introduction of smoke-consuming stoves in their houses would cost. Further, if they could lay down (say) £5 per room, their landlords would not permit the alteration without an undertaking to restore the ordinary stoves at the conclusion of the tenancy, when, I suppose, the tenant is to go and repeat the expenditure in his new dwelling. If, without altering our fire-grates, we are all to use anthracite, what will be the price of this kind of fuel, brought as it is on one only line of railway and without sea-competition? The writer in question reminds me of a French princess of the olden time, who advised the poor to eat pie-crust in default of bread.—I am, &c.,

"Stupid and Selfish."

PUBLIC IGNORANCE AND QUACK INGENUITY.

To the Editor of the Journal of Science.

SIR,—A quack who has his head-quarters near Westminster Bridge has an ingenious method of beguiling the public. He tells his hearers that if a person affected with incipient consumption blows through a glass tube into water it will at once turn milky, and invites them to make the trial. As the liquid which he offers is lime-water, the result follows as a matter of course. He then adds a few drops of his medicine (containing some acid) to the water, when the cloudiness at once disappears. This he argues is a proof that the same remedy will eradicate consumption from the human system. Multitudes of those present believe him, and buy his secret remedy.—I am, &c.,

A STUDENT.

REPLY TO "TRUTH SEEKER."

YOUR letter anent Mr. Tennyson does not fall within our competence. We admit that he is no friend of Science, but we cannot, on that sole ground, defend every person and every thing he may attack. If he has libelled Medicine and Free-Thought, both have established organs and writers competent to take up their respective causes.

THE EDITOR OF THE JOURNAL OF SCIENCE.

NOTES.

The Royal College of Science and South Kensington.—We quote the following letter from the "Freeman's Journal," and we trust that some Irish member will take the advice of our esteemed friend and contributor, Professor R. Galloway:—

"47, Leeson Park, November 21st.

"Sir,—The Lord Mayor desires decentralisation as regards Irish institutions. Allow me to state two facts, out of many, to show the desirability for this change. The Department of Science and Art at South Kensington governs, as most of your readers know, the Royal College of Science in Stephen's Green; that College costs the taxpayers as much as one of the Queen's colleges. Last session (1881-82) the Professor of Botany and the Professor of Zoology had one solitary paid student between them. Two scholarships are given away at the end of each session. Last session there were only two students for the two scholarships, and there would not have been two except that one had been sent over from England.

"If any Irish member would move for and obtain a Parliamentary inquiry into that institution, the facts that would be revealed would be so astounding that it would result, I feel certain, in the decentralisation both of that and the other Government institution in Kildare Street.—I am, Sir,

"Robert Galloway."

Professor S. Thompson points out the little-known fact that Swammerdam anticipated the famous initial experiment of Galvani by more than a hundred years. Being on a visit in Tuscany, in 1678, the illustrious Dutch naturalist showed to the Grand Duke that when a portion of muscle of a frog's leg hanging by a thread of nerve bound with silver wire was held over a copper support so that both nerve and wire touched the copper, the muscle immediately contracted.

The Rev. L. J. Templin ("Kansas Review of Science") makes some remarkable comments on the "wastes of Nature," both in the organic and in the inorganic world.

Mr. Merrick, in an elaborate memoir sent to the Entomological Society, contends that the distribution of the Tortricidæ points to the former existence of a great southern continent, by which Australia, Africa, and South America were connected at an early epoch. He strongly condemns the present classification of the Micro-Lepidoptera, and insists upon a more general and careful study of the neuration of the wings.

In South Africa a bitter hostility prevails between the dogs belonging to the Aborigines and those of the European settlers, whether Dutch or English. If a straggler of either kind falls in with a number of the other he rarely escapes with his life.

Now the question of "thought-reading" is receiving the attention of many thinkers, the following incident recorded in "Men of the Time" may be worth notice:—"As Louis Blanc was returning home one evening in October, 1839, he was suddenly assailed from behind by some ruffian, who inflicted a violent blow with a stick on his right eye. The author of this cowardly attempt—which was made the day after M. Louis Blanc had published a review of Louis Bonaparte's work, 'Les Idées Napoleoniennes'—was never discovered. M. Louis Blanc had a brother one year younger than himself, who was at that time at Rodez, in the department of l'Aveyron, and who entertained so strong a conviction that his brother was being assaulted at the precise moment when it really occurred that he was induced to write at once for information to Paris. This incident was the origin of M. Dumas's 'Corsican Brothers,' the main subject of which is the preternatural sympathy between two brothers." It may be mentioned that the death of Louis Blanc followed that of his brother with very little interval.

The Bishop of Manchester in a harvest thanksgiving sermon, is reported to have said:—"There was a progress of science which was causing very serious apprehensions in the minds of many, and not altogether without cause, for as yet the tendency of science could hardly be said to be determined, and we did not know whether it was going to take up a direct antagonistic position to religion and morality or not? Was science going to be atheistic? Some of its professors, no doubt, assumed that attitude. It was distinctly assumed by Haeckel and Büchner, and perhaps by a few nearer home, and he was sorry to see that hasty letter of Charles Darwin, written when he was ill, and, perhaps, hardly capable of fixing his mind on the question, which might seem to shake men's faith in a revelation and a life beyond the grave."

According to "Les Mondes," English soldiers rank among the worst fed in Europe. The daily ration of a Swiss soldier is 1062 grms. of solid food; that of a Russian, 1019 grms. About the middle of the scale comes Belgium, 770 grms. Then follow England, 672 grms.; France, 661 grms., and Italy, 637 grms.!

According to Prof. F. Bauher (Vienna Academy of Sciences), the thorax of the Hymenoptera is composed of three ordinary rings. In the Diptera the dorsal side of the first abdominal ring is reduced to one-half, and is attached to the second abdominal ring, which it resembles. The thorax of the Diptera is constructed like that of the Lepidoptera, though the latter have a mesophragma divided longitudinally, and the former an entire diaphragm.

Prof. A. Lacassagne (" Revue Scientifique ") gives an assay on " Criminality in Animals " which coincides very closely with our article on " Animal Depravity " (" Journal of Science," 1875, p. 415).

M. Millet, in a paper read before the Société d'Acclimatation, gives some interesting particulars concerning the stork. The male arrives first to take possession of the old nest, and the female follows some days later. If frost or damp is expected the male covers his brooding mate with dry grass. The number of young brought out is generally five. The stork arrives in France on an average about March 24th, and leaves about August 12th.

Attempts are being made to acclimatise in France *Pucrasia macrolopha*, a bird nearly allied to the true pheasants, but surpassing them in the quality of its flesh.

Mr. F. Cope Whitehouse makes the startling assertion that Fingal's Cave is probably an artificial excavation. His arguments are entitled to serious consideration.

Mr. Horatio Hale, in a paper read at the late meeting of the American Association for the Advancement of Science, suggests that the Red Indians of America were originally immigrants from Europe.

According to the " Popular Science Monthly," " the degree of barbarism in any community is measured by the impunity with which its members seek their gratification at each other's expense." This is a home-thrust for dog owners.

Messrs. Mawson and Swan have made a small accumulator weighing about five pounds, which is capable of working one lamp continuously for two hours when fully charged, or for a much longer time by turning off the light when not wanted. Irrespective of the use of the electric lamp for illuminating purposes, in combination with very sensitive dry plates, it be all that is required for the taking of micro-photographs.

At a recent conversazione of the Royal Microscopical Society, an adaptation of the incandescent light was exhibited by Messrs. Mawson and Swan, of Newcastle. The carbon loop was enclosed in a very small tube, which enabled the light to be brought quite close to an opaque object, which was thus illuminated without any assistance from a condensing lens. On another microscope the light was placed close beneath the object, and was attached to a simple contrivance, which enabled it to be rotated eccentrically to the axis of microscope: in this case a high power, 1-12th in., was employed, and the effect with *Pleurosigma formosum* was very good. Some experiments were tried with the ordinary condensing lens on opaque objects with good results, and when electricity can be more conveniently obtained the lamp will no doubt be used to a great extent. The source of power in this instance was a series of Bunsen cells.

M. Jousset de Bellesme, a Professor at the School of Medicine, at Nantes, was about to deliver at the commencement of the college session a discourse entitled "Reminiscences of Claude Bernard," but was formally prohibited from so doing by M. Duvaux, the Minister of Public Instruction. The liberty of thought and speech is therefore not established in the French Republic. The most daring utterances in this discourse are:—"He (Claude Bernard), amidst the almost general decay of French science, the fruit of *official centralisation*, has for a moment made other nations forget the alarming distance they have put between themselves and us"; and "There are no stakes and fagots in our days, but there is the Academy. We are not afraid of being burnt alive, but of not being elected an Academician."

The latest "refuter" of Darwinism is one C. M. Renooz. He contends that man is the product of the Evolution not of animals, but of plants.

M. W. D. Le Sueur ("Popular Science Monthly"), in reviewing Mr. Goldwin Smith's critique on Mr. Spencer's "Data of Ethics," pertinently remarks that "with a strange inconsistency the partisans of a supernatural view of disease are always ready to apply themselves most vigorously to abating by natural means the chastisements which they say are meant for their good."

According to H. Cl. Zimmermann the atomic weight of uranium must be assumed = 240.

M. Rey de Morande seeks to explain the retreat of vegetation from the Polar regions by the gradual decrease in the diameter of the sun, which was once large enough to irradiate simultaneously both the terrestrial poles.

The new National Museum at Dublin, if built upon the plans drawn out by Mr. J. L. Robinson, will be a splendid and commodious edifice, affording ample space for the National Library, and suitable rooms for the Royal Irish Academy and other scientific bodies.

Dr. J. Burdon Sanderson, F.R.S., has been appointed to the new (Waynflete) chair of Physiology at the University of Oxford.

Mr. H. D. Valin accounts for the formation of prairies to the west of the Mississippi by the supposition that they represent ground which has always been inundated or subject to periodical inundations. They rest generally on Silurian rocks.

The Aurora Borealis of November 17th is reported as having been observed over a great part of Europe, and as having been accompanied by striking electric and magnetic disturbances.

M. G. Calmels ("Comptes Rendus") has studied and described the poison-glands which are found in the skin of the upper surface of the trunk and the limbs of the toad. The skin-glands of the lower surface do not secrete poison.

M. E. Dauwe, of Maldeghem, near Bruges, observed a lunar rainbow on October 29th last.

Mr. G. S. Gardner, F.G.S. ("Geological Magazine") challenges the generally accepted theory of the permanence of oceans and continents on the faith of facts connected with the distribution of plants and of land-mollusks.

The "Gardeners' Chronicle" gives an interesting account of the effects of the stinging tree, *Laportea gigas*. The pain produced by the sting of a single hair on the right hand gave rise to remarkable symptoms, the pain being confined to the right side of the body and being succeeded by a numbness and slight paralysis. Besides the pain, a sensation of losing the senses, or rather of becoming insane, was experienced. The severe symptoms lasted two hours; the spot pricked remaining constantly painful for nearly a month after being stung. There is here scope for research, both chemical and physiological,—the latter of course not in this "free" and favoured country.

M. Beketoff, a Russian sanitarian, has come forward as the advocate of a vegetarian diet. He maintains that, even in Australia, the number of cattle tends to decrease daily.

"Les Mondes" claims explicitly the discovery of the pulmonary circulation of the blood for Andrea Cesalpino.

Dr. O. Loew ("Archiv. f. d. ges. Physiologie") concludes, from a series of recent investigations, that the unformed ferments have not been proved in any case to be other than albumenoids. The peptic and amylolytic ferment of the pancreas, and also the diastase of malt, are albumenoids of the peptone character, and agree in this respect with the papaine of Wurtz.

According to E. L. Larkin ("Observatory"), on the 16th of April last there occurred simultaneously a magnetic storm, an aurora of unusual splendour, and an extraordinary agitation in the sun, 111 spots having been counted during the day.

At the December meeting of the Entomological Society there was exhibited a supposed viviparous moth (*Tinea*), sent by Dr.

F. Müller, of Santa Caterina, Brazil. This is the second known instance of viviparity among the Lepidoptera.

At the same meeting was exhibited a fig-insect (*Cynips*), received by Sir Sidney Saunders from Madagascar. In this species the intermediate pair of legs is wanting, being represented merely by a pair of rudimentary lobes.

J. Reinke (" Pfluger's Archiv.") concludes that there are no galvanic currents circulating in the living vegetable cell. This is in opposition to the view of Velten.

According to Pflug (" Centralblatt Med. Wissensch.") pulmonary disease with the formation of tubercle is occasioned by microscopic *Actinomyces.*

Prof. Just shows that the green parts of plants under the influence of sunlight have not the power of decomposing carbonic oxide (carbon monoxide). On the contrary this gas has an injurious effect upon plants, though less decidedly than upon animals.

H. Struckmann (" Archiv. f. Anthropologie ") gives an interesting account of the fossil bones in the " Rhinoceros Cavern," at Scharzfeld, in the Harz. It contains the remains of three distinct and successive Faunæ.

By an oversight we omitted to notice in our last issue the death of the eminent meteorologist and seismologist, Prof. Palmieri.

Prof. Kolbe has proved experimentally that beef, kept in an atmosphere of carbonic acid, remains sound and of a natural flavour for some weeks. Mutton, treated in the same manner, becomes offensive in about eight days.

In addition to MM. Faye and Hirn, Dr. D. Tommasi takes objections to the theory of Mr. Siemens on the conservation of the solar energy.

Mr. St. George Stock pronounces spiritualism to be " the apotheosis of evolution."

The Home Secretary has, by various orders under his hand, altered the close time for wild birds in the following counties and districts :—Huntingdonshire, Liberty of Peterborough, and Isle of Ely (in Cambridgeshire), so as to be from the 15th of March to the 31st of August, both dates inclusive ; Essex so as to be from the 15th of March to the 1st of August, both inclusive. The statutory close time is from the 1st of March to the 1st of August. These orders will permanently supersede temporary orders to the same effect, for one year only, made last year.

Twentieth Year of Publication.

THE

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AND ANNALS OF

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THE

JOURNAL OF SCIENCE.

FEBRUARY, 1883.

I. NEW RESEARCHES ON CANINE MADNESS.

By Frank Fernseed.

AMONG the sources of peril to which mankind expose themselves rabies, or, as it is popularly called, canine madness, holds a somewhat exceptional position : one of its worst features is its uncertainty. The cobra is always dangerous, and whenever we see one we may therefore avoid it, or kill it if we have the means, no man saying us nay. If bitten we are not left in uncertainty, but in a couple of hours at the most we know the worst. Further, though venomous serpents do occasionally intrude into human habitations, yet we never find them brought purposely into public conveyances. In England, too, we are practically free from the assaults of the death-snakes ; for although the common viper (*Berus letalis*) still occurs in our heaths and woods, it is never met with in the streets of towns and villages, or on public roads. Even in its favourite haunts it glides away at the sound or the vibration of an approaching footstep. Thus the chances of any person being bitten by this reptile are exceedingly small. Only one fatal case is known as having occurred in Britain during the last half-dozen years. But the dog, unlike the cobra or the viper, is always with us, and is able—under conditions far from fully explored—to inflict a bite fully as hopeless as that of any serpent. As hopeless, I say, but far more distressing, since the person bitten, provided only his skin has been broken, does not know for months—possibly for years—whether he may not be suddenly attacked with a disease which has hitherto mocked all medical skill.

Nor is this lamentable consummation at all rare among us. The deaths from hydrophobia in England and Wales reach a yearly mean of 35,—a considerable number to be sacrificed to the mere caprice of some of our neighbours.

I am well aware that certain moralists, and a few other writers who might perhaps be styled *im*moralists, maintain that the original cause of rabies must be sought in confinement, chains, and muzzles. To this assertion I am content to oppose the well-known fact that this disease is by no means uncommon among wolves in France, Spain, and other continental countries, and is exceedingly common among jackals and pariah dogs in the East.

Having thus proof positive that increased liberty is no remedy, the public may turn with the greater interest to the recent experiments which have been undertaken by M. Pasteur, with a view to tracing the origin of, and if possible discovering, the remedy for this scourge. I premise that these experiments of necessity involve a certain amount of what is, in Victoria Street, shrieked at as "Vivisection." But even experimental research has been so far beset with difficulties. Hitherto the saliva has been the only matter in which the presence of the virus has been actually proved; but, as M. Pasteur remarks, "the saliva, whether inoculated by a bite, or by direct injection into the cellular tissue, does not communicate the disease with certainty, and when the malady does appear it is only after an 'incubation' of variable and undetermined length." Hence the results of experimentation have been hitherto of little value. Had M. Pasteur been a Lord Chief Justice or a Mænad he might have moralised on the uncertainty of "Vivisection" and have abandoned the study of rabies in despair. Fortunately he was a man of Science, and as such he acted on the principle that if any method of experimentation gives doubtful results it must be modified. He found that the principal seat of the poison of rabies is the central nervous system. Here it may be obtained in a state of purity and in sufficient quantity. Further, if this matter is brought in contact either with the surface of the brain or is injected into a vein, rabies is induced not possibly and after the lapse of a longer or shorter time, but invariably and immediately. Thanks to these two observations the disease can now be scientifically studied, and the value of any proposed method of treatment can be rigorously tested. The principal results which M. Pasteur has formally obtained, and which he now puts forward as fully established, are that mute and furious rabies—or rather all the forms of the disease—proceed from one and the same virus, and that it is possible to proceed experimentally from either of these types to the other.

Nothing is more fluctuating than the symptoms of canine madness. Each case has some characters peculiar to itself, and there are grounds for admitting that these characters depend on the points of the nervous system where the virus is localised.

In the saliva of a rabid animal the virus is associated with various microbia, and the inoculation with this saliva may bring on any one of three kinds of death, *viz.*, death by the new microbion which the author has described as the salivary microbion, death owing to an extensive production of purulent matter, or, lastly, death by what is commonly called hydrophobia. Hence it will be perceived that the bite of a rabid animal is an affair even more serious than is commonly imagined, since a triple danger has to be encountered. I may add that a bite even from an animal in a normal state of health is far more to be dreaded than a wound received from any clean tool or weapon.

The rachidian bulb of a person or of any animal who has died of rabies is always virulent, but the virus may be also found in the whole brain or in some of its parts, or in the spinal marrow. The virulent matter taken from the spinal marrow is quite as deadly as that from the rachidian bulb or from any part of the brain, and the virulence persists until the nervous matter is attacked by putrefaction.

Rabies communicated by the injection of the virulent matter into the blood offers characters which often differ decidedly from the furious madness brought on by a bite, or by placing the virus in contact with the brain. Hence it is probable that many cases of so-called mute madness escape observation.

The author is led to the belief that in inoculations by way of the blood the spinal marrow is the part first attacked. Inoculation in a dog with the saliva or the blood of a rabid animal does not always prove fatal, but such a recovery is no certain protection against the effects of a fresh inoculation with the pure matter of rabies, whether by application to the brain or by injection into a vein.

M. Pasteur has met with cases of spontaneous recovery in dogs after the first symptoms of rabies had appeared, but never after the disease has reached its acute stage. He has also observed cases where the first symptoms had subsided, but the disease had nevertheless reappeared after a long interval (two months) without any fresh infection. Under such circumstances the acute symptoms were followed by death as in ordinary cases. The question may here be raised whether rabies is always fatal in wild animals, or whether, as certain facts suggest, recovery is not uncommon? M. Pasteur's experiments have not, of course, shown whether idiopathic rabies differs at all in its character from the disease as communicated by inoculation. In one experiment, made in 1881, three dogs were inoculated. Two of these quickly became rabid, and perished, whilst the third, after having manifested the first symptoms, recovered. This last dog was twice re-inoculated in 1882, the poison being brought in contact with the brain, but did not become rabid. Here, therefore, we have a case of the disease in a mild form proving a prevention against future infection. This result M. Pasteur considers the first step towards discovering a means of preservation from rabies. He possesses at present four dogs which are proof against the infection, whatever may be the method of inoculation used and the virulence of the matter; whilst other dogs, inoculated with the same virus, invariably perish. M. Pasteur raises the question whether these four animals owe their impunity to spontaneous recovery from a mild attack which may have escaped observation, or whether they are naturally and exceptionally refractory to the infection? This question he is now endeavouring to decide.

M. Paul Bert has also called attention to some experiments on the same subject which he made in the years 1878 and 1879, and which have been to a great extent overlooked. He effected, on one occasion, the total reciprocal transfusion of the blood between a healthy dog and one in the height of rabies. The former, though kept afterwards under observation for a year, showed no signs of madness, whilst the general condition of the mad dog was somewhat improved, and it survived, apparently, forty-eight hours longer than it would otherwise have done.

M. Bert has also examined in which of the constituents of the slaver of a rabid dog the virus is contained. This slaver is a very complex mixture, containing—in addition to the saliva of the parotid, the maxillary, and sublingual glands—the mucus of the mouth and of the respiratory passages. To decide this question he has inoculated series of dogs with the mucus and with the liquid expressed from the different salivary glands of dogs killed in the height of rabies. The salivas—in the strict sense of the term—have never communicated rabies, whilst the mucus from the respiratory organs has done so, and must be considered as the deadly portion of the slaver. This explains the great irregularity in the action of the bite of mad dogs, since one bite may convey a portion of the mucus into the wound, whilst another may not.

In accordance with M. Pasteur, M. Bert remarks that the saliva of a mad dog, if it does not communicate rabies, may still prove fatal by producing serious local injuries. Out of fifteen dogs inoculated in 1878 seven were attacked with suppurations, which in four cases proved fatal. Hence the secretions and tissues of rabid animals appear to have septic properties over and above the special rabic virus. If the slaver of a mad dog was filtered through plaster the filtrate was found inoffensive, whilst the residual solid matter communicated rabies.

In connection with this disease there is a question which urgently calls for investigation in some country where such researches are possible. It is said that the bite of the skunk, when the animal is in its normal condition, invariably, or at least generally, brings on rabies. Is this actually the case? If so, does this dangerous property extend to the skunk of Java, or is it peculiar to the American forms? Does idiopathic rabies occur in any other of the Mustelidæ? These questions are of the greater importance as dogs, in attacking weasels, polecats, &c., may easily happen to receive a bite. I have even heard it asserted that rabies does not originate among dogs, but is derived from some animal of the weasel group—a very hazardous assertion. We do not even know whether this disease ever originates spontaneously in any of the Felidæ, Hyænidæ, or Ursidæ.

The recent investigations of MM. Pasteur and Bert lead to certain important conclusions:—

1. The bite of a rabid animal is more dangerous than is commonly supposed, since if it fails to communicate rabies it may occasion other serious affections.
2. The bite of any animal not in a rabid state has to be regarded not as a simple wound, but as more or less poisonous, since the saliva is always liable to introduce microbia into the tissues and the fluids of the animal or person bitten. This conclusion fully agrees with the results of common observation.
3. The fact that a dog which has bitten any person does not itself die of rabies, or does not even exhibit the more marked symptoms of that disease, is no proof that it may not have been slightly rabid, and have communicated the virus to the person bitten.

The question will now be asked, Do the recent studies of M. Pasteur hold out any promise of deliverance from the perils of canine madness? It seems, *per se*, not unlikely that a "vaccine" for rabies may be discovered, *i.e.*, a modified virus, which if introduced into a dog or any other animal may render it proof against the effects of an infected bite. But should such a safeguard be discovered its adoption, in this country at least, would be very doubtful. The outcry raised by the Anti-Vaccinationists, and in general by the "Anti" portion of the public, would be truly deafening. It has been already shown that much of the evil might be practically done away with by the simple expedient of nipping off the points of the teeth of dogs, so as to render the penetration of the skin less likely. But the dog-worshippers, who are the very heart of the Bestiarian movement, object, and their outcries carry more weight than do considerations of public safety.

II. THE BIRTH AND EVOLUTION OF THE SOLAR SYSTEM.

TRANSLATED FROM PAGES 113 TO 132 OF "GEDANKEN"
(1857, Philadelphia, published by Thomas).

By O. REICHENBACH.

Introductory Letter to the Editor.

THE doubts raised in Prof. Klinkerfues's criticism of "Two Planets beyond Neptune" ("Journal of Science" for June, 1882) against the nebular theory as applied by Laplace to the solar system, and the objections of Judge Stallo in his "admirably written" "Concepts and Theories of Modern Physics," made me think of putting before your readers the exposition of a theory which neither fully adopts nor rejects, but modifies and brings into a more definite shape, that of Laplace.

When "it is not the purpose" of Judge Stallo "to discuss the merits" "of the meteoric theory in detail, or to express an opinion as to its soundness and sufficiency," but he yet thinks it "to stand in favourable contrast to the nebular theory," I beg him to consider that a nebula is a gathering of infinitesimal meteors, and that the nebular theory does not exclude the formation and absorption of larger meteors by a nebular system in formation or formed, and that the "meteoric theory" is a vague inordinate assertion, but no theory at all. I had almost given up my intention, when it was revived by some passages in the Anniversary Address (1882) of Dr. William Spottiswoode to the Royal Society. He said—"On September 17th an observation apparently unique in the history of Astronomy was made by Mr. Gill at the Cape, who watched the comet right up to the sun's limb. . . . It could not, however, be detected in the sun, and this circumstance of appearing neither bright nor dark when in front of the sun appears to suggest a very small substantiality or great separation of the cometary matter."

The comet reappeared with a nucleus, or with more than one nucleus; the mere insubstantiality and division could therefore not have been the sole cause of its imperceptibility. —the refraction of light inside the extended and increased atmosphere on the night side of the nucleus diminishing in size would be in itself an auxiliary reason, but the sentence "The water of the ocean is continually decomposed at the limits of the atmosphere, passing into new combinations again changing in the course of its return: this electro-magnetic process, going on around the sun on a grand scale, exists around the planet in a small way" ("On some Properties of the Earth," p. 318) may well apply to a comet near the sun. At all events the comet has presented to various observers appearances and phases the interest in which may perhaps procure some attention from your readers for the following development theory of the solar system.

Dr. Spottiswoode also said—"Nor must I omit mention of Dr. C. W. Siemens's bold and original theory of the conservation of the solar energy, which has already given rise *to so much discussion*. It will be sufficient for me here to say that upon the questions therein raised the last word has been by no means said; and that whether the theory be ultimately established, or whether, like a phœnix, it shall hereafter give rise to some other outcome from its own ashes, it will ever be remembered as having set many active minds at work, and will always have a place in the history of Solar Physics." Dr. Spottiswoode attributes to the theory a novelty it cannot claim, as he may see from a letter, "The Sun," in the "Engineer" of February 26th, 1869, where the views expressed with regard to the maintenance of the "solar energy" differ only in this, from those of Dr. Siemens's theory, that they distinguish between the action of the individual sun with an atmospheric limitation and the interaction of the various bodies of the whole solar system. The exaggerating way of putting the theory Dr. Spottiswoode may find in "On some Properties of the Earth" (1880):—"We cannot consider the heat emitted, whatsoever may be the manner and kind of its development and nature, as merely the product of the sun, and as being an arbitrary quantity independent of the solar system; we might rather compare the sun to a furnace, consuming the smoke and gases its heat sets free, to feed its own fire and luminary, and to assist in the process of reduction—a metaphor which I do not intend to introduce here as a hypothesis."

The "active mind" which enters into the spirit of my "development theory" may learn that there is a difference between a system forming and formed, and that the process of maintenance of what we may call the seasonal energy of either planet or sun is to be distinguished from the more permanent life process of the system.

Translation.

Although in the important distribution of planets general qualities of absolute magnitude, density, depression, velocity of rotation, and absence of moons show themselves as dependent from their solar distances, half the great axes of their orbits, yet this dependency in each of these groups is not to be maintained. We know for the present, as I had occasion to remark, of no inward necessity, of no mechanical law of Nature, which, like the beautiful law that connects the squares of the times of revolution and the cubes of the great axes, might represent the elements named in each group of planetary bodies as dependent from their solar distances.

If Mercury, the planet nearest the sun, is the most dense, six or eight times so as some of the farther ones, Jupiter, Saturn, Uranus, Neptune, the series proves very irregular in Venus, Earth, Mars, or in Jupiter, Saturn, and Uranus. The absolute magnitude increases, as Kepler already pointed out, with the distances in general, not in particular. Mars is smaller than the Earth, Uranus smaller than Saturn, Saturn smaller than Jupiter, and they are succeeded by a host of planets too small for exact measurement. The velocity of rotation generally increases with distance, but it is with Mars slower again than with the Earth, with Saturn slower than with Jupiter.

The world of bodies and forms is in the enumeration of its proportions to be represented as a fact, as existent and real, not as an object of intellectual conclusions, not of a connection discovered in its causes. No general law has been found here, neither for the celestial spaces, nor for the Earth in the site of culminating mountain-chains, or in the shape of continents. They are acts of Nature, born from the conflict of manifold conditions of projecting and attracting forces to us unknown. We step here with strained and unsatisfied curiosity in the unexplored empire of the becoming. —(Alexander von Humboldt.)

As socially we strive for legality, so we presume it everywhere in Nature. Kepler's sagacity remarked that strange chasm between the planetary distances. Lagrange proclaimed, with his authority as mathematician, that the density of planets increases with distance. Descartes had his theory of vortices; Newton's views told with characteristic reserve; Leibnitz, Franklin, and above all Laplace, formed their theory with more regard to Nature and Mechanics; Kant, Oken failed by profusion of ideas. Every philosopher, mathematician or not, high or low, ancient or modern, has meditated about order in Nature.

I have tried to trace these laws. I am no mathematician, not possessed with the analytical power of some to give to my thoughts that decisiveness of formulæ, often ill-founded, nor with the philosophical profundity of others; but refraining imagination, shaping my conclusions with the precaution of him who does not feel himself strong in the possession of knowledge, instrument, and reputation, I reach maybe at truth by logic.

The probability of a central sun, bright or dark, has been suggested; it is an explanation too eager for explaining. I deny this proposition. Indifferent how far we may recede with sun round sun, a central sun contradicts our concept of the immeasurable; it is a beginning, a fixed point from which Archimedes might lift creation from its hinges; it would be a centre, in the infinite there is none. The idea of the infinite and eternal is necessary, therefore true; there is something of which we must confess, with Schiller, "What the mind of the mindful cannot see, a childlike heart in its simplicity does find." If we examine only what is nearer, we do not know where we arrive, but we advance.

We shall not meditate if our sun revolves round another sun, it cannot escape existing influences; if it migrates from or to other systems which be the path of the individual between individuals. It has not always been what it is; it had its process of generation and growth, like man and worm; but the act of engendering—of something out of nothing—touches on what we cannot comprehend.

We see the nebulæ of the heavens; they are resolved into stars by the telescope. "Telescopes and microscopes sometimes confuse pure reason; one is contented to find grubs," says Goethe. On earth there also are nebulæ; they condense to drops; a similar process exists in space,—we see it pass. An atom, we are told, is the beginning of man, two excentric atoms perchance; why not of sun and planets? sucking nutrition from a fog growing round them, becoming something from nothing.

Two central oppositions at least this nebula must contain; they are unequal, for they sprung from an inequality; they revolve more or less regularly,—revolving they advance; they received movement as they received existence; they are through that which was; without movement they cease.

We will rest in this mystic, yet true, circle, out of which we cannot step; we have only to inform ourselves about those ordinances of gravity which must connect and rule, in those relations of masses, distances, densities, velocities, inclinations, and excentricities. Manifold contradictions seem to mark themselves under comparative examination of our planetary system.

I do not pretend that what I find is always correct and complete in all its details, but I am convinced that it is true in principle and method.

To meet criticism beforehand I mention the series of planetary distances by Titius (Bode's law), derived from Kepler; it is an accord falsely taken in what there is, without theoretical foundation and explanation, but it attracts our attention. It has been said that the series does not entirely agree with reality. That should be the last objection. Where is there a law without cause of disturbance in itself? How many irregularities have been discovered in the motion of heavenly bodies, and, because nevertheless the law was believed in, one sought after reasons for these irregularities and often found them; sometimes not yet found them, sometimes pretended to have found them. If we have reason to believe in a principle, apparent contradictions shall not induce us to reject it forthwith, but to trace those contradictions to their sources, and our principle may come forth stronger than before from doubt and contest.

I shall at first make some concessions to probability, but we are taught to consider it as a law. Observation gives the degree of probability; do we succeed to foretell events, probability increases to certainty.

Since a comet was seen to divide, such possibility cannot be doubted. I have demonstrated which shape rotation gives to a spheroid. Let our Earth be carried nearer the Sun by great excentricity of orbit, this new excentricity must be connected with a process of dissolution and condensation different from the actual one. The distribution of surface in continents and seas is disturbed; the earth alters the excentricity of its shape. As it gets nearer the sun, pressure, polar-ward undulation, condensation increases; dissolution is likewise augmented, and with it the effect of centrifugal force which carries matter to the equator. Thus a tendency to more rapid and to slower rotation is developed,—a tendency of the one part to make the slower rotation more rapid, and of the other part to make the more rapid rotation slower. In this action and reaction of different strata the interior condenses, the exterior dissolves, the fluid increases, the interior still possesses part of acquired velocity of rotation, the fluid part undercuts the solid with its small axis, as if an increased retarding sea suddenly poured under and uplifted Asia, America, the whole solid surface, which pressing forward were thus together, and divided cast off by the nucleus, the boiling vapours rushing between. The dissolved materials press each other, coagulate, surrounded by liquid and gas.

I should try in vain to follow the process of planetary rupture in a descriptive manner. The enumeration of simple effects of gravity, the development of some proportions, is not only more demonstrative, but also more comprehensive, than to introduce gravity in all its multifarious metamorphoses,—heat, magnetism, electricity, light,—which enliven the picture, attract imagination, but prejudice intelligibility, and carry belief and disbelief with them.

There exists in the planetary distances an interval which early and often attracted the attention of "conjectural astronomy." Examined more closely, indifferent if in consequence of an error in a star catalogue or of the intellectual motive of a fantastic hunt after law, it was found to embrace a host of planet dwarfs moving in intricate orbits.

As there can be no certainty, *à priori*, we shall put down, without pretension to accuracy, the farther limit of the zone of the asteroids at 680 solar radii from the sun. Likely that we do not know all planets, but those largest in mass, and therewith the whole mass approximatively. Including some to be found, making another supposition, I put down the planetary mass at 1-680th of that of the sun; it amounts to the so-manyth part, as the sun is its own radii distant from the farther limit of that zone which is designated as "separating contracts."

The body exists by opposition, for by it density exists, which like all qualities is comparative. Suppose the whole planetary mass at this distance of 680 solar radii from the centre of gravity of the sun, without regard for the present that it must also extend away from the sun or this zone. Imagine the sun dissolved, reaching there, and both bodies of like density. Those two nebulæ with incipient nuclei, those vapour atmospheres, touch each other, flowing in one. There is no reason that their mean density should differ; their distance is proportional to their masses, divided by the square of distances, if we call distance the distance of the surface of the one from the centre of gravity of the other. The difference of density can only result from the variety of motions, and the development of this variety of motions we have to find.

The radii of these equally dense nebulæ with incipient nucleus (atom) are to each other as the cubic roots of their masses,—consequently the radius of the planetary mass is to that of the sun as 1 to 8·78, or roundly 8·8. Motion there must be; it depends on the relation of masses, and the original existence of motion decides the relation of masses: these are correlates; we have only to find what is and how it is.

This planetary mass revolves round the sun, because motion develops itself into regular rotation. With which velocity does it move? with the same mean one with which a planet would move there—about 54 Paris feet in the second. Translation is consequent on rotation; the converted sides repulse, the averted ones attract each other, as I proved. A point under the equator of this planet would then move in its rotation through about 54,000 Paris feet in a second, if such planet were of equal density with the sun moving at a distance of 680 solar radii. The rotatory action cannot be more rapid, only slower than the translatory one, than the quantity of motion obtained at all, and there is no reason that it should be less, as the densities of both bodies are equal, the distances their radii, the sun the larger one.

The velocity of motion is a gradual result of opposing masses. A planet thought possible to glide on the surface of the actual sun would move through 1,400,000 Paris feet in a second; consequently on the surface of that planetary body of 1-680 mass of equal density through

$$\frac{1{,}400{,}000'\sqrt{(\sqrt[3]{680})}}{\sqrt{680}} = \frac{1{,}400{,}000'\sqrt{8{\cdot}8}}{8{\cdot}8 \times \sqrt{(8{\cdot}8)}} = 160{,}000 \text{ feet.}$$

But the planetary mass did not have this density at the time; the solar mass could, notwithstanding its 680^3 times inferior density, produce a velocity of 54,000 feet next to its surface, for its centre of gravity was at a very little different distance then, as now, from the point of motion. The planetary mass also was 680^3 times less dense; its radius was not 1-8·8 of the present, but of the then existing solar radius; it measured 77·3 of the actual solar radii. The velocity which this mass was able to give to a mass at its surface was—

$$\frac{160{,}000'}{\sqrt{680}} = \frac{54{,}000'}{8{\cdot}8} = 6200 \text{ feet}$$

in a second, which is still pretty near the velocity of a point under the equator of the sun in the revolution round its axis. The time of a whole revolution then was so much slower as the radius was longer; as the sun gradually attained to its present density the time of one revolution decreased; the distance run through in a certain time by a point of the surface remained the same.

Founding our structure on some remarkable but indefinite premises, we obtained conclusions which prove that the rotary velocity of the sun is nothing accidental, and that the planetary one is only altered by division of mass. We have gained the starting-point of the process. We shall consider if further deductions strengthen the probability that our supposition was correct.

Which was the centrifugal force on the surface and at the equator of the sun? Not as now—

$$\frac{1}{77{\cdot}3 \times 680}, \text{ but } \frac{1}{77{\cdot}3},$$

and which at the surface of the planetary mass is—

$$\frac{77{\cdot}3}{1},$$

which means it became under the equator 77·3 times greater than gravity.

By the thus resulting continuous separatory thrust the planetary mass could not simply dissolve, but it had to exercise its effect against the sun and away from it, as the sun, too, affected by its motion the planetary mass; there was down and up undulation, a process which formed the central part of the planet in a revolving evolution cycloid,—that is the most descriptive expression,—and gave it besides conical elongations, polar axes, points of concentration, polar regions.

I call the solar radius R, the actual one r, $R = 680\,r$. The planetary distances in r are, r being the natural foot-rule which we must apply, $r = 96{,}350$ geographical miles (fifteen to a degree).

Mercury	... 83·6 r	Jupiter	... 1117 r	Uranus	... 4012 r
Venus	...156 ,,	Saturn	... 2047 ,,	Neptune	... 6447 ,,
Earth	...214 ,,			A ...	... 9050 ,,
Mars	...326 ,,			B ...	...16560 ,,

The centrifugal force of the planet exceeded attraction 77·3 times; it repulsed the solar mass, which is 680 times larger.

$$\frac{77{\cdot}3}{680}=\frac{1}{8{\cdot}8}\ \mathrm{R}=77{\cdot}3\,r,$$

slightly less than the distance of Mercury. The centrifugal force of the sun was 1-77·3 we should conclude; it repulsed the planetary mass, which is 1-680 of the solar mass,—

$$\frac{680}{77{\cdot}3}=8{\cdot}8$$

of the then planetary radii, consequently to 1360 r distance. But we have to deal not with a point, but with a body on whose dimensions the applied force produces unequal effects, —moreover, with a body whose centrifugal force exceeds its gravity, which, as it recoils, melts under way, which at the same time continually revolves, throws its mass forward and backward, and leaves it behind as itself moves off, which stretches itself, which with its extension alters the translatory and rotary velocity of its strata, which rebounds from the sun but at the same time is re-attracted towards it, which is an elastic body from which the sun concentrating recedes, as the planet before the sun. Step by step we must go with this column of matter, whose axis of rotation measures only 1-17·6 of its axis of central extension.

(To be continued.)

III. ON ARTIFICIAL LIGHT.

By An Old Technologist.

IF we compare the present times with the past we find in no respect a more utter contrast than in artificial light. There is firstly a great change in its quantity. In the proudest days of classical antiquity, just as amidst the barbarism of the Middle Ages, people of all sorts and conditions appear to have utilised the natural light of day to a much greater extent than do we. Noon, the culminating point of the sun, was approximately the middle of men's working and waking hours. Little or no daylight was spent in sleep, and, conversely, but little of the hours of darkness was devoted to work or amusement, or any kind of activity. It is quite outside of my business to trace the gradual changes which have brought about an entire divorce between the conventional and the astronomical meaning of the terms morning and evening. I may, however, briefly glance at the principal causes which have led to this social revolution. Foremost must rank the spread of civilisation, or rather of luxury, to countries situate under a high latitude and having a cold climate.

In the regions bordering on the Mediterranean the daylight, even in winter, lasts long enough for the inhabitants to get through a reasonable sufficiency of work. Early rising, too, in all but exceptional seasons, is there pleasant. With us the daylight during at least four months of the year is insufficient for the purposes of business. The mornings, too, except in summer, are damp and raw, and only men of exceptional vigour are found rising early from choice. The habits of late rising and of working by artificial light having once been formed, these practices have gone on extending.

Another reason for turning night into day is the greed connected with the organisation of modern society, which forces almost every man to devote more and more of his time, as well as of his energies, to the mere earning of a livelihood. The day is not considered long enough for work, and the only time left to the many for recreation, or even for thought, is the night. Hence we need wonder little that England, as the focus of industrial greed,* should be the most given to late hours. It is singular that among the points which the advocates of thrift systematically overlook the excessive outlay for artificial light should be included. Would we, or could we, once more make noon the middle of the day we should compass an annual economy of some millions sterling.

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* Other nations are fast following our example.

As regards the modes of production, artificial light has undergone changes no less striking than those which have affected its quantity, and to these it may be useful to advert, in view of the still further revolution which is, so to speak, at our very doors. A hundred years ago the art of lighting up private houses, public buildings, and streets had made but doubtful progress since the days of the Cæsars. In the majority of houses a single candle, made of soft tallow and requiring frequent snuffing, was the only light in a sitting-room. People in good circumstances used the "mould," made of a purified tallow and having a better appearance, though not giving a more powerful light, and needing the use of the snuffers. To have two such candles on the table was thought, even in the first quarter of the present century, a proof either of wealth or of extravagance. Among persons of high station wax candles were in use on especial occasions, and were carefully extinguished when no longer needed.

Lamps were never in former days as much used in England as on the Continent. They were generally confined to workshops, warehouses, passages, stables, &c., where a candle might be extinguished or made to "run" by the force of the wind. In such localities they were commonly, like the street-lamps, fed with whale- or seal-oil, and gave out a very unpleasant smell.

An important part in open-air lighting was played by torches or links, objects which have now disappeared from daily—or rather nightly—life, but which undergo a temporary resurrection in times of dense fog. As a curious survival may be noticed the gigantic extinguishers still to be seen attached to the front gates of some mansions in London. Into these, when the occupants of the carriage had alighted, the footmen thrust their torches.

The first great change in artificial light was the common introduction of gas. This invention, after having survived alike the usual opposition which every novelty has to encounter and the somewhat exaggerated praises of its admirers, has been found lacking in not a few points of importance. We are told, with technical truth, that gas is cheaper as a source of light than oil, tallow, &c. But there is here a practical fallacy. The light, *e.g.*, of a candle or a lamp is thrown full upon the objects to be illuminated, leaving the rest of the room comparatively obscure. Gas, except when conveyed by means of a flexible pipe to a movable table-burner, is burnt in the upper part of the room, and illuminates the ceiling and the walls quite as much as the books, papers, &c., on the table for which it is chiefly wanted. It is doubtless true that for 1¼*d.* we may obtain as much light with gas as we could with colza oil burnt in a solar lamp for 2¾*d.* But if, as is generally the case, we have to produce at least three times as much light with gas as with an oil-lamp, in order to read or work with equal ease, the economy disappears. I think the experience of every man who has introduced gas into his house will be that he is out of pocket by the change. He obtains more light than he did from lamps, but not where it is most wanted.

Another defect of gas as a source of light is its unsteadiness. Theoretically it may be, perhaps, possible to make gas burn with a perfectly steady flame; practically speaking this desideratum is not reached. If the flame of a gas-jet, of whatever construction, is carefully watched it will be found constantly flickering. The effects of this unsteadiness are, in the long run, exceedingly irritating to the eye.

A third, and perhaps more important, shortcoming lies in the products of the combustion of gas, which are of course emitted into the atmosphere of the room. Among these must rank sulphurous acid, which in contact with the moisture of the air passes gradually into sulphuric acid, and has an injurious action upon pictures, wall-paper, the bindings of books, &c. Ethylene is probably never entirely absent among the products of the combustion of gas. The amount of watery vapour and carbonic acid is also excessive. Hence, except there is special provision for ventilation at the level of the ceiling, the atmosphere of a room lighted brilliantly with gas becomes most oppressive, and persons much exposed to it suffer from headache and languor. This is the case with visitors to our theatres, few indeed of which are even tolerably ventilated. Still worse is it the case with the assistants of certain drapers, &c., who are obliged to work by artificial light every evening save Sunday from 4 to 9, 10, and in some cases even 11 p.m. The nature of the atmosphere in these shops may be guessed from the quantity of moisture which may be seen runnning down the insides of the window-panes on a cold evening. The carbonic acid given off must reach a correspondingly abnormal proportion.

A further disadvantage is the quantity of heat generated by the use of gas as an illuminant. I will admit that there are in our climate very few weeks in the year in which heat, *per se*, can be regarded as a nuisance. But heat, like light, may be produced and applied in the wrong place. If we consider the tendency of heated air to rise upwards, we shall see that the sources of heat should be placed as low as possible. In a room lighted with gas this arrangement is reversed. Up aloft is, so to speak, a stagnant lake of hot air in which the heads of the inmates are plunged, and are further heated by radiation from the ceiling and the upper parts of the walls. At the bottom the air is cold. I have observed a difference of 9° F. between the temperatures of such a room near the ceiling and near the floor respectively, and I have reason to believe that there are cases where a much greater difference would be registered. If there is any trust to be put in the old maxim, to keep the feet warm and the head cool, this is a condition the very reverse of salutary, and experience fully confirms the supposition.

I know it is contended that, for equal amounts of light, the heat generated by oils, tallow, stearine, wax, paraffin, &c., is greater than that thrown off by gas. This is true, but not to the purpose. The heat coming from lamps and candles is developed at a lower point in the room, so that there is a less extreme difference between the ceiling-temperature and the floor-temperature. Again, as I have already mentioned with reference to the question of cost where oils or tallow are used, a less quantity of light is demanded.

Another defect of gas is so well known that we may feel surprise at the little attention which it practically receives. Gas is poisonous if inhaled even very largely diluted with air; and such mixtures, further, according to their proportions, are more or less powerfully explosive. Hence in premises lighted with gas there is always a certain margin of danger which does not exist where candles or non-volatile oils are used to give light. A slight defect in the work of the plumber or of the manufacturer of gas-fittings,—neither of whom is immaculate,—or a casual oversight on the part of a child or a servant, may lead to a serious calamity. Even if a man can guarantee the utter absence of carelessness within his own doors, or if he eschews gas-lighting altogether, he is still at the mercy of accidents as long as it is used by his neighbours or by the local authorities. Many of my readers will remember the explosion which began in Charlotte Street, Fitzroy Square, and which extended—

tearing up streets and wrecking houses—even to the east side of Tottenham Court Road.

I may therefore sum up the defects of gas-light as including unsteadiness of flame, emission of products of combustion harmful to persons and property, production of high temperature in upper parts of rooms, and danger of leakage or escape, whilst at the same time the commonly alleged economy of gas is in practice doubtful, or at most very slender.

Hence it is evident that coal-gas as a source of light is very far from perfect. It appears, also, that its defects are of a nature not to be readily overcome or avoided by any improvement in its manufacture or mode of supply and consumption. It is scarcely conceivable that gas can be purified in such a manner as to be absolutely free from sulphur. Still less can it be rendered non-explosive when mixed with common air or compelled to burn with the absolute steadiness of a well-constructed lamp.

I turn now to another great step in the production of artificial light—the introduction of the mineral oils. These oils, when burnt in proper lamps, have certain advantages as well as defects. They are much more economical than refined vegetable oils, and give a brighter light than coarser seed or fish oils. They are probably in practice cheaper than gas, since they produce the light where it is wanted, and not in the upper part of the room. They are free from sulphur, and hence do not injure textile goods, books, furniture, pictures, &c. Otherwise their products of combustion are little different from those of gas. Being generally placed on tables, &c., they do not overheat the upper part of the room.

But to balance these good properties come defects which cannot be ignored. Like all lamps, they are much more troublesome than candles or gas-jets. They must be cleaned, trimmed, and supplied with oil by daylight, and can never be safely replenished whilst burning. If inferior qualities of oil are used explosions of a serious nature may happen. The glass chimneys are liable to break if imperfectly annealed, or damp, or if the flame is turned up too suddenly. The overturning of a lamp—a not impossible occurrence—may easily give rise to a conflagration. Nor can such lamps be safely turned down if for the time being a good light is superfluous, for when burning dimly the products of their combustion are exceedingly unwholesome. To sleep with a petroleum lamp in the bed-room, turned down to a mere speck of light, may prove fatal. Hence mineral oil, though it is of immense value and utility, is still not all that we could wish for.

There is, therefore, room for the improved system of lighting which is just being introduced—the electric light, in its two forms of the "arc" and the "glow" lights.

Being neither an inventor in this department nor a shareholder or official in any electric light company, I may, it is to be hoped, be recognised as impartial when I pronounce this system to be "the light of the future."

Its advantages over gas and oil lamps are the following:—There is an absence of products of combustion mingling with and deteriorating the atmosphere. Most of the electric lights are enclosed in hermetically sealed globes. There is no consumption of oxygen, no escape of sulphurous or carbonic acid, ethylene, or other product of combustion. The ceilings are not blackened; books, &c., are not corroded, and respiration is not interfered with. Practically no heat is liberated, so that the upper part of the room is not hotter than the floor. The feeling in such a room, however brilliantly lighted, is the same as in the daytime.

The colour of the electric light, though not absolutely identical with that of sunlight, makes a nearer approach than that of any artificial light hitherto used. With the arc light colours can be judged and compared as in the daytime—a property which during the short dull days of winter will be of great use in dye-, print-, and colour-works.

A notion prevails that the arc light is more blue than daylight. This is, according to the best authorities, an error, since if the two are actually compared the arc light is decidedly the yellower of the two. But being much less yellow than gaslight, or than other artificial lights with which it might come in contrast, it seems slightly bluish. Hence it is in some quarters evil-spoken of, because it shows up artificial complexions and textile goods of inferior colours. I have heard that certain drapers of the modern encroaching school, who had introduced this light into their shops, have found it disadvantageous, as revealing unpleasant truths.

The glow light or incandescence light approaches gas more closely in its colour, and hence may be preferred by those whose eyes have got accustomed to a yellow light.

The expense of the electric light varies very considerably according to the locality. Where a constant source of moving power exists near at hand, such as a stream of water, light may be obtained for merely the interest on the first cost, the depreciation and the carbons consumed,—in all a mere fraction of the expense of a much inferior quantity of light obtained with gas. Mr. W. Crookes, F.R.S., has already laid before the public the comparative cost of gas and of the electric light (incandescence) as applied in his house, the advantage being in favour of the electric light, though produced under disadvantageous circumstances; that is to say, the motive power had to be produced solely for the purpose with a "silent gas-engine,"—certainly not the most economical method of obtaining mechanical power, though the only one available in such a locality.

In an experiment in street-lighting carried out by the firm of Siemens and Halske, the eminent electrical engineers of Berlin, the cost of lighting up a given area at an equal intensity with the electric light was found about half that of gas.

As here also the motive power was not obtained in the most economical manner, there can be no doubt that the general introduction of the electric light will represent a considerable saving in money, over and above its other advantages.

IV. SUN-SPOTTERY.

IN MEMORIAM OF THE LATE PROFESSOR STANLEY JEVONS.

By A. H. Swinton.

PERHAPS in no way has Science exerted a more beneficial influence on society than by the innovations it has made during the nineteenth century on the old astrological notions of our ancestors. As far back as the seventeenth century the discovery of the revolution of the globe showed that their ideas of aberrant planetary motions were mere optical illusions,* and paved the way to a recognition of the sun as the true centre of the universe. It was but a step then to attribute changes in terrestrial phenomena to corresponding changes transpiring in its light-giving photosphere, and it must remain a standing marvel that philosophers should have remained so long without seizing the proper clue to unravel the many mysteries that surround us. Nor is the observation of spots on the sun's photosphere any new thing, There is the ancient Chinese record purporting to refer to these very spots, and various scattered notices coming to us from the Middle Ages. But these records, if they possess any precision, are involved, and apparently unsuitable to convey a just conception of the solar cycle: a glance over them reveals at once that any system deduced from them is not in accordance with the normal eleven-year periodicity of the sun-spots,—in this case the only criterion. The application of the lens to the telescope in Galileo's time caused the sun-spots to become a subject of more exact scrutiny, and from this period until the days of the elder Herschel they became a subject of comment in astronomical circles, and, as might appear, did not wholly escape the notice of the fair sex, who patched their faces to imitate the sun. To Herschel belongs the credit of propounding the question whether these solar changes did not affect the recurrent seasons, and consequently influence the corn harvest in our planet; but his investigations of this subject would appear to have been somewhat premature. The labours of the indefatigable Schwabe, in daily chronicling the number of spots on the sun's face, have more lately been supplemented by photographic observations, and the result is that these spots have been observed to come and go, their maximum of prevalence being attained normally every eleven years.

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* The question whether the position of the planets is in relation to the sun-spots has been discussed by Dr. Muirhead (Phil. Soc. Glasgow, vols. for 1875, 1880) and Mr. F. B. Edwards (Nature for 1882, p. 293).

It is important, then, to inquire if there be any natural phenomena that reappear on our planet in cycles of eleven years which may be referred to the influence of these sun-spots. We find, for example, that the time of sun-spots has been shown to coincide with a period of cyclones and hurricanes, a period of greatest rainfall, and a period of electric storms; and, on the other hand, that the time of no sun-spots coincides with a period of deficient rainfall and tropical drought. All this is of the first commercial importance. When storms increase shipwrecks become numerous, and a general depression ensues in certain industries, while an augmentation of the rainfall decidedly means a deficient harvest in this country,—witness the cry of distress that arose in 1879 from our agricultural districts. When tropical drought arrives famines are prevalent, and heat and insects conspire to injure cargoes of imported grain; locusts make organised inroads on the standing corn lands. None of this matter is surmise, but the conclusion of legitimate deduction, arrived at by strict observation and computation on the part of the leading meteorologists of the day. On the other hand, electric storms are calculated to disturb the recent enterprise in electro-magnetic cables, lighting, and locomotion, that has so fair a promise, while the question of spots or no spots will be brought to our very homes in the electric light.

That other phenomena that affect the well-being of mankind may safely be attributed to the sun, the following fragment of a chronicle of the eruptions of Vesuvius and Etna, the result of some considerable research, will demonstrate:—In 1766 sun-spots were at a minimum, and Etna was in eruption, and the next year Vesuvius. In 1769 sun-spots were at a maximum, and Vesuvius erupted during the space of three years. In 1775 sun-spots were at a minimum, and an eruption of Vesuvius that commenced in 1773 terminated in 1776. In 1778 sun-spots were at a maximum, and there was an eruption of Vesuvius for two years, followed by an eruption of Etna for two years. In 1784 sun-spots were at a minimum. The previous year Vesuvius and Etna were both in eruption, the activity of Vesuvius lasting for three years. In 1788 sun-spots were at a maximum, and the previous year Vesuvius and Etna were both in eruption, the period of activity lasting three or eight years. In 1798 sun-spots were at a minimum, and Etna was in eruption for about five years. In 1804 sun-spots were at a maximum, and Vesuvius was in eruption. The succeeding year both Vesuvius and Etna were active. In 1810 sun-spots were at a minimum, and the previous year both Vesuvius and Etna were active, the activity of Vesuvius continuing for two years, and being followed by an outbreak on the part of Etna. In 1816 sun-spots were at a maximum, and Vesuvius was in eruption during two years, and afterwards Etna was in eruption during the space of one year. In 1823 sun-spots were at a minimum, and Vesuvius had been erupting during two years. In 1828 sun-spots were at a maximum, and Vesuvius was active. In 1833 sun-spots were at a minimum, and there was a corresponding activity for six years on the part of Vesuvius, while Etna was in activity the year previous. In 1838 sun-spots were at a maximum, and Vesuvius and Etna were both active. In 1842 they were at a minimum, and Etna was active. In 1847 sun-spots were at a maximum, and there had been eruptions of Vesuvius for three years previous; the first year Etna was also erupting. This period was succeeded by a slight eruption on the part of Etna. In 1855 sun-spots were at a minimum, and there was an activity on the part of Vesuvius for four years. In 1860 sun-spots were at a maximum, and Vesuvius was active during the space of two years. In 1867 sun-spots were at a minimum; Etna was in eruption two years previously, and Vesuvius the two subsequent years; the latter year Etna was again erupting. In 1870 sun-spots were at a maximum, and there was an eruption of Vesuvius extending over three years. In 1876 sun spots were at a minimum; Vesuvius was in activity, and there had been eruptions from Etna during the space of three years.

I have thus adduced sufficient to render it palpable that Solar Physics, in its concrete form a matter of astronomical observation, is capable of being turned to utility when applied to establish statistics that are in legitimate connection. It is, however, evident that these statistics are general in their enunciation, and that they may or they may not affect pecuniary interests or produce commercial panics. However let us look at the economic matter in the same light as the natural phenomena. Supposing the said pecuniary gains and losses, and the said commercial panics, should occur in cycles, and that these cycles should prove to coincide with the sun-spot cycle. What then? Must we at once fly to the assumption that, although the periodicity is identical, there is a similarity and not identity of causation. Let us take the well-known case of contradiction presented by the harvest and crops in India. Messrs. Norman-Lockyer and Hunter have constructed a Table which clearly shows how the famine years in Southern India coincide with the years of fewest sun-spots when the rainfall is deficient; the late Prof. Stanley Jevons has constructed a table that shows that corn was at its highest quotation, in the Delhi market, at times when sun spots were normally at a maximum and the rainfall in excess. What then? Is there here anything but what might be supposed to result from a difference of latitude or surroundings? May not rain that refreshes a parched land arrive with different auspices in a more humid climate? Yet who is the individual required to solve this problem, the meteorologist or astronomer? Decidedly not; it belongs to the speciality of the naturalist.

Why should we not, then, have an efficient staff of observant naturalists as adjunct to each Solar Committee of the future? In vain the men of figures will puzzle when it appertains not to their sphere to investigate. In vain red-tape clerks and smart newspaper reporters will raise a cry of sun-spottery! sun-spottery! when the oracles are at fault.

Let us suppose a case in point. Suppose the quotations of corn in this country do not constitute a cycle at harmony with the seasons and sun-spots, what are the unknown factors? Astronomers, clerks, and reporters grow confused alike; some talk of Providence, others believe in Zadkiel's Almanack. Well, here certainly are some of the desiderata. It has always appeared to me a desideratum that merchants in grain should keep strict record of weeviled cargoes and weeviled granaries; as merchants, by registering the profit and loss, and, if also entomologists, by noting and estimating the increase and diminution of the noxious species of beetle. It has always appeared to me a desideratum that farmers should note when the chaff falls from the threshing red with the maggots of the wheat midge; that they should chronicle the growth of charlock, poppies, and other tares that carpet their fields; that loss from smut, mildew, and rot should become a matter of exact register. These agencies are all injurious to corn, and their virus will vary as the average dryness or humidity of the year; then, over and above, there remains the question of export and import. When all these little trivialities are understood, and not till then, shall we be fairly in a position to clench the problem of Solar Physics applied to the monetary statistics that so absorb our attention.

But it may be asked, Do the corn quotations in this country never constitute themselves into a cycle, moving in consonance with the years and sun-spots. Let us awake to the broader prospect furnished by the past history of trade and science. It is the rain that causes the green herb to grow for the service of man; it is the rain that renews the face of the earth and paints the vernal meadow with leaves and flowers. In this humid climate, however, an excess of rainfall is a detriment to the harvest-field in the opinion of every well-informed agriculturist. Especially does an excess of rain mar the promise of the wheat, the wheat plant which replenishes the marts of the Mediterranean and the United States of America being much less truly acclimatised with us than its bearded sisters the barley and oats, that conserve their wiry and amazonian natures despite of culture. The rain, again, which is here the fostering or malignant influence, is itself but dropping vapour distilled by the superior agency of the sun from off the water surfaces that cover the earth, and the said vapour or cloud is distributed to its allotted place by the winds. In the case of both rain and wind heat is the motive power, and any increase or diminution in the heat of the sun must depend on changes in the potency of its photosphere, and such changes as we believe to be indicated in the appearance and disappearance of the solar spots.

Of late years the rainfall of the British Islands has become an object of special study and investigation, with amateurs as well as paid officials. Mr. J. J. Symons, of the Meteorological Society, who has recently published statistics gathered from numerous quarters, takes occasion to refer to the existing caprice of heaping ridicule on the astronomical precedent of referring the phenomena of Nature to fixed and pre-determinate laws. He calls attention to the circumstance that the wettest years in England of late prove to have been 1836, 1841, 1848, 1852, and 1860, and that the first, third, and fifth of these years fall into a twelve-year period. He further calls attention to the circumstance that the driest years in England of late prove to have been 1826, 1834, 1844, 1854-5, 1858, and 1864, and that the second, third, fourth, and seventh of these fall into a ten-year period. Now it is at once manifest that the twelve-year period of wet years he here indicates coincides with the solar cycles, and that the dates only differ by two years on the whole from the epochs of most sun-spots assigned by Prof. Wolf. The ten-year period of dry years, which alternates with these wet years, will then consequently correspond to the minima years of solar spots, from which in three of the instances they differ but one year.

If there is indication that the sun-spots may be traced in the amount of English rainfall, the question then arises—How does our rainfall affect the growth and ripening of the wheat? Let us summarise the corn statistics. Mr. J. E. Thorold Rogers, some years back, undertook the arduous labour of tabulating the price of corn in England from the thirteenth down to the commencement of the seventeenth century, and has embodied the result of his researches in four goodly volumes. Going over the columns of his Tables, and counting eleven years for the return of the maxima of sun-spots, we observe an unmistakable rise in the price of wheat at every year the pencil checks,—from 1259, when the liberal-minded Henry III. became the victim of his turbulent barons, to 1582, the year when the calendar was rectified by Pope Gregory XIII. As a rule we notice that the disposition to rise precedes the years to which we assign an excess of solar spots; and this occurs with a regularity that might surprise those who, drawing from the depths of their inward conscientiousness, have hitherto failed to perceive the supremacy of our public light in mundane matters. These cycles of high prices are marked by depressions for the most part well indicated, when, as would appear, the gracious goddess of the golden year has harnessed her dragons, and emptied her cornucopia on old Albion's shore. After a lapse of sixty-six years the musty Audit Books of Eton College furnish us with the prices of middling or mealing wheat per quarter, at Windsor Market, from 1646, the year after the defeat of Charles I. at the battle of Naseby, down to 1826, when George the Fourth was king. During all this long time there undulates a marked rise and fall in the wheat quotations, the crests of the waves corresponding as they rise to the epochs of most sun-spots determined by Prof. Wolf. Nor is there here any irregularity to be discerned, save that these crests have reached a climax sometimes a little before, and sometimes a little after the year specified; or, more rarely, they are a little bifurcated. From 1771, previous to the alteration of the Corn Laws, down to 1852, when they were repealed by Sir Robert Peel, we possess Tables of the average price of British corn per imperial quarter in England and Wales, as ascertained by the receiver of Corn Returns; and from 1859 down to the present time we possess the Parliamentary Reports or the Agricultural Returns for Great Britain. Throughout these long columns of quotations the same fluctuation of price in correspondence with the sun-spot years is easily checked off, the only peculiarity presented to the eye being that the monetary cycles exhibit a tendency to become somewhat less marked, owing to the increasing import of grain that began to take shape about the commencement of the eighteenth century.

The prices of barley and oats fluctuate as the wheat quotations, but in cycles less pronounced. Thus 1879 was a wet rainy summer over the corn lands in the South of England, and it brought with it great distress among the agricultural classes: wheat, however, actually fell in price, on account of the large importation from America at this time. On the other hand, 1878 and 1880 were years when the summer rainfall over the West of Scotland fell to a minimum, and they came with a rise in the price of *British oats*, according to the Excise Statistics. From this it would appear that oats suffer less from a wet season than wheat, and I believe the same is true of barley in less degree. As regards insect ravages, as late as 1876—which was both a locust year and a year of minimum sun-spots—the wheat crops of America, according to Government Statistics, gave the poorest yield per acre they have done these thirteen years past. Here are reasons, then, why the prices of grain should not roll and break as the solar phases transpire; the machinery of Nature is ever complex,—we must know the disturbing causes and understand the conflicting tides. For the present it is sufficient to know that the sun-spots raise the waves. Perhaps the refusal of mother Earth to nourish her offspring awakes the passions of mankind. Will anyone disprove it,—we can all ridicule,—is famine a provocative to war? War influences commerce by checking the export and import of grain. War and famine conspire to produce a commercial crisis; there was one in 1857, and if you count the elevens backwards and forwards you may find more.

The days may come—and I do not despair of seeing them—when the sun-spots shall not only be a subject of investigation for the curious, but when they shall photograph themselves on the frontal of our social life, as of olden time the patches flecked the countenances of the scientific fair. Evidently a large class of economic phenomena, the subject of recurring comment in the daily papers, are under the influence of the sun-spots, and there is a growing tendency on the part of our men of Science to clinch the matter. The sun-spots are now supposed to affect our globe in an immediate manner, and to constitute a telegram that is immediately transmitted to the forces that rule our atmosphere. Take in illustration Prof. Balfour Stewart's late communication to "Nature," on what he has styled Magnetical and Meteorological Weather. As is known, the movements of the magnetic needle when rendered very sensitive are three—the secular, annual, and diurnal. The secular variation is due to the movement of the two points of greatest cold about either pole of the earth, which attract the needle, and by their motion draw it from east to west, and *vice versâ*, in about 236 years. In its yearly and daily variations the needle follows the sun flower, as one would infer from being repelled by the heat-wave that passes with the sun over the earth. Thus it is farthest from due north about the spring equinox, and nearest that direction at the summer solstice; at sunrise it progresses slowly westward, an hour or two after midday it turns and begins to go back, and about ten o'clock at night it regains its original position, remaining almost stationary until sunrise next morning. The daily movements of the needle are not only horizontal, but also vertical; and these movements, horizontal and vertical, increase annually as the sun becomes leperous with spots. When the sun is most spotted the oscillation of the needle increases, and one might surmise this to be directly due to the influence of the spots as they hourly form and vanish.

Now Prof. Balfour Stewart says, in the communication in question, "Sometimes we have very hot days and cold nights in which the diurnal temperature range is very great, and these are succeeded by close rainy weather in which the diurnal temperature oscillation is very small. In like manner we have sometimes a very large, and at other times a comparatively small, diurnal oscillation of the magnetic needle; so that it also is affected by the influence of a magnetic weather." He then shows, by a Table, that the diurnal oscillation or declination of the needle corresponds in this country to the weather or range of temperature that may be expected to arrive six or seven days afterwards. As a reason for this he adduces evidence that the temperature range weather, when once produced, travels from west to east, taking probably on an average eight or nine days to cross the Atlantic; and that there is also evidence to show that the declination range weather travels likewise from west to east, but quicker than the temperature range weather, taking about two days to cross the Atlantic.

The conjecture is not remote if we follow the reasoning here suggested, that the fine and dull weather we experience on this planet vacillates as the spots come and go on the sun's photosphere; and if the weather, may it not be that the storms do so likewise? Now at the moment of writing a circumstance has occurred that would certainly lend colour to such a conjecture. On the 18th of November, 1882, a huge spot was seen on the face of the sun; on the 22nd of the same month warning came from New York that a dangerous disturbance would arrive on the British and Norwegian coasts between the 24th and 26th, attended with gales, snow, and rain. As I am now writing, on the 27th of November, wind, snow, and rain are holding jubilee, and raving about the sun-spot. Have we here any true connexion, or merely a coincidence?

V. FRESH NEWS ON EARTHWORMS.

IT is noteworthy how much we find is to be learnt concerning even the most despised plant or animal when once some genuine observer points the way. Darwin's researches on the earthworm had extended over forty years, yet the subject is not yet exhausted. There was room left for Mr. Kinahan to make valuable and interesting observations, which are recorded in our last volume.* MM. Pasteur and Feltz have shown that these little creatures may be a source of danger by bringing to the surface virulent matter from the bodies of buried men and animals. M. Trouessart has observed that a common species (*Lumbricus agricola*) constructs towers at the mouth of its burrow, just as is done, according to Darwin, by the nearly allied genus *Pinchœta*. And now we find that Prof. Victor Hensen, Herr von Lengerke, and the Danish zoologist P. E. Müller† have all been engaged with the study of earthworms, and have elicited additional facts in connection with their habits, their food, their part in the formation of "vegetable mould," as it is commonly called, and their influence on the fertility of the soil. This, as we shall see below, is probably even greater than was supposed.

It was formerly considered that humus was derived entirely from the decomposition of vegetable matter. Darwin, as we know, showed that animal agency played here an essential part, and concluded that all such mould had been passed again and again through the intestinal canal of worms, and owed its characteristic properties to this action.

As far back as 1865 H. Thiel, without reference to the earlier researches of Darwin commencing in 1837, observed that the roots of red clover penetrate into the soil to the depth of 2 yards and more, by means of tubes or channels pre-existing in the sub-soil. These channels he thought might have been formed by the roots of trees which had formerly traversed the soil and had subsequently decayed; or by some animal. What animal he does not appear to have ascertained.

In 1877 Prof. Hensen made a further advance. He seems to have been aware of Darwin's earlier memoirs on the subject, but not of the observations of H. Thiel. He observed that the channels by which the roots of plants penetrate into the subsoil are chiefly made by the large earthworm (*Lumbricus terrestris*), which at the same time lines them with finely divided mould.

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* Journal of Science 1882, p. 331, 377.

† *See* Landwithschaftliche Jahrbücher, 1882, p. 661; Der Norddeutsche Landwith, 1881, p. 568; and Biedermann's Central Blatt, 1882, p. 723.

Hensen finds that the large earthworm operates in the subsoil, whilst the smaller species (*L. communis* and others) work in the upper layer of the soil. All of them in the night thrust their bodies partially up out of their holes, and drag in decaying leaves for food. This author illustrates his work with two plates, showing the course of the worm-holes, the manner in which they are lined, and the roots by which they are traversed. The holes or tubes he finds most distinctly marked in sandy soils, where they descend vertically to a depth of 3, 4, and even 6 feet, and then extend further in a horizontal direction. The sides of these tubes are studded more or less closely with little black prominences, often of a line in diameter, which are the excrement of the worm, as appears on microscopical and chemical comparison with the excreta taken from the body of the worms.

In tubes which have existed for some time there are generally found roots of the plants which are growing on the surface. Such roots, of $\frac{1}{2}$ to $\frac{1}{4}$ line in thickness, run even to the very end of the tubes, giving off all the way minuter rootlets covered with capillaries which spread over the sides. This phenomenon, says Prof. Hensen, may be best observed with plants of the cabbage tribe. It will be readily admitted that such roots are placed under very favourable circumstances for growth and nutrition. The matter taken from the sides of the tubes, and that from the intestines of the worms, differs little in its composition from leaf-mould.

From his analysis Hensen concludes that worms certainly eat soil, but only in order to make their tubes. Their real nutriment consists of half-decayed vegetable, and incidentally animal matter. Ordinary garden mould would scarcely afford them a sufficient quantity of assimilable matter, though leaf-mould might do so when not too far decayeed.

As regards the fertility of a soil the earthworm exerts a favourable action from several points of view:—

1. It insures an equable distribution of leaves and other loose portions of organic matter, and removes them from the action of the wind.
2. It promotes the decomposition of such organic matter by comminution.

3. It distributes the fertilising matter in the subsoil, and renders it more accessible to the uniform action of air and moisture, thus aiding in the liberation of the mineral constituents of plant-food.

It is well known that soils, and especially subsoils, may contain a large proportion of the elements necessary for the nutrition of plants, but in such a state as to be practically unavailable. To render them assimilable they have to be decomposed by the action of the carbonic acid contained in the atmosphere, and by water. These agents are admitted into the soil by the mechanical operations of agriculture, and probably even to a greater extent by the unceasing work of the earthworms. Hence Prof. Hensen makes the startling—but we believe perfectly justifiable—assertion, that chemical analysis of a subsoil gives no sufficient insight into its fertility if the number of worm-holes are not also taken into due consideration.

As regards the quantity of earthworms living and boring in the soil, we do not find any absolute agreement among different authorities. This is merely what might be expected from the differences of soil, climate, season, and other conditions. Hensen calculates per acre of arable soil 110 lbs. of worms, weighed with their intestines emptied of soil. H. von Lengerke takes a considerably higher estimate. In an acre of meadow-land he found 176 lbs. of *L. terrestris* and 550 lbs. of *L. communis*, or in all 720 lbs. of worms. In strange contrast with these figures would be the number discoverable in suburban gardens around London, which in barrenness are probably unsurpassed.

Prof. P. E. Müller has studied the behaviour of worms in woodland soils, especially in the beech-woods, in which Denmark is—or perhaps rather was—so rich. The beech tree flourishes in the mild beech-humus, but dies off on the beech-moors,—that is, as we understand the author, on soils where beech-woods have once existed. In the former class of soils earthworms live in plenty, whilst in the "beech-moors" they are entirely wanting, and indeed animal life is altogether very sparingly represented.

On mossy, heathery, and boggy soils, worms are not numerous in most parts of England. According to Mr. Kinahan the same rule holds good in Ireland.

Like Prof. Hensen, but unlike Darwin, P. E. Müller is of opinion that the earthworm is not nourished by the soil. It eats the soil, indeed, but as a method of opening its tubes and removing the excavated material. Any vegetable matter thus swallowed will of course be utilised as nourishment.

As regards the horizontal subsidence of stones, rocks, &c., Müller does not, like Darwin, find the phenomenon satisfactorily accounted for by the removal of the earth from beneath by worms, and its gradual accumulation around their sides. Here his observations are completely in accord with those of Mr. Kinahan as laid down in our last year's volume (p. 377). It does indeed seem that in this respect Darwin has somewhat overlooked other agencies. To one of these, so familiar as to be forgotten, we must beg for a moment to direct attention. Everyone must have noticed how on a frosty morning—especially if there has been previously much wet weather—pebbles, fragments of stone, &c., which have been imbedded in the ground, appear to have sunk down below the surface. This is to be noticed even in compact gravel-walks where worms are entirely absent. The reason of this is plain : the water held by capillary attraction within the pores of the stone expands on freezing, and thrusts the loose soil upwards. When a thaw succeeds, the soil or gravel falls back to some extent into its old position, but not entirely so ; the edges of the stone after each such alternation are more and more covered, until at last it disappears from sight. Something of the same nature will take place, to a slight degree.

Another agency which must probably contribute to the subsidence of stones, and even to their translatory movement on the slope of a hill, must be sought in the expansions and contractions which are known to take place in the earth's crust in accordance with changes of temperature and barometric pressure, and in those slight vibratory movements which are far from uncommon. It is well known that if we mix together in a box fragments of stone, &c., with sand or other similar powder, and set the box aside in what we think a quiet place, in the lapse of years these different materials will sort themselves out, the larger fragments finding their way to the bottom. This process is constantly going on in Nature, as far at least as regards stones resting on arable soil, loose sands, gravels, and peat earth. Mr. Kinahan, in the article referred to, makes mention of a number of other agencies which are undeniably concerned in the result. Hence without seeking to deny that worms take a part, and occasionally a prominent part, in the subsidence and displacement of stones, we submit that a complication of causes is here concerned.

P. E. Müller combats an objection which has been brought forward,—to wit, that worms cannot effect very great changes in the subsoil. As Darwin admits, they live chiefly in the upper stratum of the soil, and only retire lower down in severe cold or in prolonged dry weather. To this Müller replies that the smaller earthworm (*L. communis*) frequents the upper layer of soil, in which it is not unfrequently frozen up in a hard winter; but that the larger species, as is maintained also by Hensen, works in the subsoil, and rarely visits the surface except in mild rainy nights.

The importance of worm-tubes in aiding the penetration of the roots of plants into the soil has also been called in question, chiefly on the faith of observations which are not quite to the point. Suppose we fill a pot with earth or sand, quite free from worms, and introduce a plant; its roots will quickly make their way downwards. But such soil or sand is comparatively loose and porous. In the fields and gardens the soil, even where it is within the action of culture, is relatively compact, and below the reach of the plough or the spade it is very dense indeed, almost impenetrable to roots. Thus the above-mentioned experiment is illusory. It is also proved by direct observation that the existing tubes or channels are preferentially utilised by the roots of plants. Thiel, to whose researches we have referred above, admits that the roots chiefly penetrate down into the substratum by means of such channels, but he doubts whether they derive any important share of nutrition from the subsoil, as they do not touch the sides of the tubes very closely, but often seem to hang in them loosely suspended.

But Müller shows, in reply, that the minute capillary rootlets are most active in the absorption of food-matters, and these are particularly abundant in the tubes in the subsoil, where they meet with favourable conditions for growth, such as an equable temperature, an unexhausted soil, a moist air, rich in carbonic acid and space for undisturbed growth. The capillaries not merely spread themselves over the sides of the tubes, but make their way into minute chinks and apertures.

Another important feature is here brought prominently forward by Prof. Müller—the underground dew. In the severe winter of 1879-80 he made the following observation:—After a frost of several weeks uninterrupted duration the frozen stratum was dug through. Immediately below it was a moist subsoil of from 1 to 2 feet in thickness, but on penetrating still lower down the earth was again drier. The presence of the moisture can be accounted for only on the supposition that the watery vapour constantly rising up from the lower strata became condensed as it approached the frozen upper layer, the immediate subsoil being thus kept constantly moist. In the worm-holes the roots thus constantly enjoyed a moist atmosphere. Prof. Müller, indeed, found them frequently covered with drops of water, and is thus led to suppose that there is in these tubes a practically incessant formation of dew. The condensed water coming in contact with the sides of the tubes will dissolve both saline and gaseous matters which are then absorbed and assimilated by the roots, which are thus supplied with nourishment as well in drought as in moist weather.

We generally find nothing in Nature which is altogether hurtful or altogether beneficial. The old and profoundly wise proverb "It is an ill wind which blows no one any good" might well have its converse, since the most beneficent and necessary agencies have their evil phase. Seeing, therefore, what an amount of benefit we receive from worms, we may well ask to see the other side of the account. Singularly enough this other side is almost wanting. It is sometimes asserted that worms feed upon the roots of living plants. This is, however, an error; they consume the roots of dead and decaying vegetation only. We may, indeed, find the earthworm active amongst rotting bulbs and tubers, but in such cases he is not the cause of the mischief. He must not, as sometimes happens, suffer for the sins of the wireworm, of the larva of the cockchaffer, and of other depredators, whether insects or cryptogamous plants.

Earthworms may sometimes cause annoyance by boring their way in or out of the soil among young seedlings, and displacing them. But neither this sin nor that of slightly disfiguring lawns with their casts can be brought into comparison with the great good which they unquestionably occasion to the farmer and the gardener.

The only really serious charge against worms is that of bringing infectious matter to the surface of the soil. But this danger we may easily avoid by treating animal matter before burial with some of the many chemicals which worms avoid.

It has been even proposed to introduce worms in localities where they are deficient, in order to ameliorate the soil. For this purpose a hole is dug out, perhaps a yard in depth and as much in diameter. If the bottom of the soil is of a very compact and retentive nature, it is somewhat broken up with a pickaxe or a crowbar. The hole is then filled up with moist sand, and receives a top-dressing of leaf-mould and rotted dung, and a few healthy worms are introduced. The operation should of course be undertaken in moist, calm, cloudy weather.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 29.)

OUR inquiry into the Education system adopted by the Department of Science and Art will be confined chiefly to the Science division; but it would be as desirable to have what may be termed an accurate "stock-taking" of the *practical results* achieved by the Art, as well as the Science, Schools: it would be very desirable, for instance, for the nation to know the proportion of French to English designs produced at the present time for our calico-printers, and the amounts paid respectively for each. Mr. Potter, the then largest calico-printer in the world, stated, in the evidence he gave before the Select Committee of the House of Commons in 1864, that prior to 1840 there was a considerable remuneration to the designers at home: we most of us, he said, kept up large establishments, and to my certain knowledge there were many men receiving from £100 to £500 a year as designers for the trade; I believe, he said, no such sums are now (1864) paid in this country. We are more than ever reliant upon the Paris *ateliers* for designs. I have, he said, made a calculation which I believe to be within the mark; I know what certain houses pay—£2000 or £3000 a year—in Paris for designs. We have regular agencies there, which we had not even a few years ago. I believe the amount paid by calico-printers *alone*, at this very time, is enormous. I may state, at once, that I know twelve houses that pay from £25,000 to £30,000 a year for designs. I believe the entire payment now in the trade for French designs alone is upwards of £50,000 a year: we get much better designs in Paris; unless it were so we should not go there, of course: we have, in the meantime, *lessened our own designing power very greatly.*

Fifty thousand a year must have been by no means an unimportant factor at that time in fostering art in Paris, by giving employment to no inconsiderable number of French artists: in any inquiry, therefore, at the present time, into the technical education of this country, it ought to be a matter of great importance to ascertain accurately whether our calico-printers are still indebted to French artists for the majority of their best designs.

Some at least of our Statesmen and Members of Parliament, and others of the community, have been led to believe that the system adopted by the Department for teaching Science in Elementary Science Schools is both efficient and economical, and that no other system could produce equal —not to say better—results at the same cost to the State. I think it can be shown—and shall now attempt to show, and I hope convincingly to the majority of impartial persons—that a system more in accordance with sound educational principles, and which would therefore produce better practical results for the nation, could be devised, and would, at least, be no more costly to the State than the present one.

In the evidence I shall adduce to show the defects and deficiencies of the present system, I shall take my facts from three sources:—1st, Public documents. 2nd, From personal knowledge. 3rd, Facts that have been accidentally given to me by gentlemen who have taught under the Department. I say accidentally supplied to me, because I did not go in search of them; and I shall be most careful in stating them —they are not in the smallest degree distorted. And this question of whether we have or have not adopted the best system for the teaching of subjects the practical applications of which ought to lead to the improvement of old, and the establishment of new, industries in the country, is by no means an unimportant one for us at any time; but it is especially important at present, when we as a nation have to face a stagnant, if not a declining, revenue, occasioned by a serious falling off of our exports both in *quantity* and *value*, owing to increased and increasing foreign competition.

It has already been pointed out that under certain circumstances the teacher may receive no payment from the Department for his year's work; but there are other exceptional cases, besides those stated in the Science Directory, which will forfeit the teacher's earnings. I will relate two that have been brought under my notice:—A few years ago a gentleman started, and taught, a chemical class in the Mechanics' Institution in this place. The examination was duly held; but when the teacher sought for payment he was informed that owing to some informality the Secretary of the Local Committee had committed—of which he, the teacher, was up to that time totally ignorant—no payment could be given to him, nor prizes awarded to the students.

When Physical Geography was one of the subjects in the Departments course, a gentleman, who afterwards related the particulars to me, started a class in the subject, and gave about a hundred lessons. The class knew their subject thoroughly; and a few days before the official examination he, the teacher, held an examination, and out of twenty questions he gave eight of them comprised the examination paper of the Department's examiner, but the pupils were awarded no marks at the Department's examination; the teacher therefore received no payment, and he consequently gave up teaching the subject. Owing to local peculiarities the pupils' vocabulary of English words was somewhat limited, and therefore they all expressed themselves very much alike; and as they were acquainted with the answers to the eight questions the Department's examiner gave, the teacher concluded that the Departmental authorities believed that the pupils had been made acquainted with their examiner's paper before going into the examination room. This was afterwards apparently confirmed in the following manner:—Some time afterwards the same gentleman taught, in the same place, a class in Geology. "The answers"—I give the gentleman's own words—"were so good that the Department would not credit my class for having written them, and an Inspector was sent who boldly accused us of unfair dealing. The candidates were asked to write the answers again, which they did, though it was some six or seven weeks after the examination. I told the Inspector I would find no difficuly in 'spotting' their questions; I showed him a few papers of questions in my note-book which would ensure answers to their questions: they allowed some on the second occasion to pass. The Local Committee complained of the unfairness of suspecting the work done by the pupils simply because their expressions were alike, if not identical." This resulted in this gentleman abandoning the teaching of that subject also.

When payment has been awarded there is frequently great delay in paying the grant. On January 23rd, 1882, there appeared in the "Standard" newspaper a communication from "A School Manager" respecting the delay in the payment of the Government grants to schools; on the 26th of that month there appeared in the same newspaper the following letter:—

> "*The Payment of Science Grants.*
>
> SIR,—May I be permitted to supplement the letter of "A School Manager" to point out that the delay in the payment of Science Grants is even worse than in Elementary Schools. Science Classes commenced in September, 1880, were examined in May, 1881, the results published in July, and the payments made in December. Most Science teachers are paid solely out of the grant. Is it not sufficient that teachers alone, of all the professions, should voluntarily undertake a whole session's work without touching payment, but they must have a gratuitous addition of five months' waiting after the results are declared? One Science teacher, who has since died, whose enfeebled constitution needed the support, and whose nervous temperament chafed against the delay of his grant (some £40) received it on the Friday before Christmas-day.
>
> "I am, Sir, your obedient servant,
>
> "SCIENCE TEACHER."

Even if the uncertainty of receiving any payment at all, and the uncertainty when it will be paid even when it has been awarded, affected only the Teacher and not the Taught, it must be admitted, I think by every one, that a system which involves all this uncertainty about the teacher's pecuniary remuneration requires at least some reforming; for it can scarcely be doubted that this uncertainty must act unfavourably in securing the best talent, and that it will only be adopted as a last resource for making a living. But these uncertainties must more or less, according to the temperament of the teacher, unfit him for discharging as efficiently as he would otherwise do, if his mind was at ease with regard to pecuniary matters, the duties of his calling. But we will now pass on to the defects and deficiencies of the system as they more immediately affect the taught, and therefore through them the nation.

Written examinations are mainly the Department's tests of the candidate's knowledge of the Inductive Sciences: the teacher, to have any chance at all in securing any payment from the Department, must, on that very account, teach his pupils to pass; whether they know the subject they are taught must necessarily be to the teacher, as far as his self-interest is concerned, of very little or no importance compared to that of their passing: he will therefore devote special attention to those who are most likely to pass,—to those who have, he finds, the best verbal memories; and that this really takes place will be proved, I think conclusively, when the number of pupils in the different Science Schools are contrasted, which will be done in a future article, with the number that present themselves for examination in the elementary stage, and these again with the number which go in for the highest, honour, examination. Here is a fundamental difference between the system of teaching carried on under the Science and Art Department and the system carried on in Germany. "It is our principle," stated an eminent German teacher in one of the Trade or Business Schools in that country, "to adapt our instruction to the wants of the *average* boy,—to see that he is brought up to the prescribed mark at the proper time;" and if England wants a good educational system—one that will be for the advantage of the nation, whether it be *general, scientific,* or *technical*—it must also be one principle; but this cannot be as long as we adopt the system of payment on results, especially as that system is carried out by the Department of Science and Art.

Another evil of the payment on the result system is that it compels the teachers, owing to small sums they can earn by teaching one or two subjects to one class, either to teach many subjects in one or two schools, or to teach one or more subjects in several schools; the teachers have, therefore, to give so much time to teaching, in order to obtain little more than a bare competency, that little or no time is left them for prosecuting their own studies so as to keep them on a level with the progress which is taking place in the subjects they teach. In what a different position, in this respect, is the teacher under this system to the teacher in Germany; in that land of learning *three lessons a day* is considered very full work for a teacher. It is thought in that country that a teacher should give no more lessons than he can give with the whole force and freshness of his mind without undue exhaustion; and, above all, he should have time for prosecuting the private studies which enhance the value and efficiency of his work, and he is only called upon to give instruction in *cognate* subjects.

In looking over, some little time ago, the Department of Science and Arts Report, published in 1881, I noticed many facts supporting what I have just stated as regards the time the teachers paid on the result system have to give to teaching: one teacher taught, according to the Report, in no less than *nine* distinct schools; another taught in *eight* schools under the Department, and in *one* at least under the City and Guilds of London Institute; and several, as shown by the Report, in *six*, *five*, and *four* different schools.

A gentleman told me a few years ago that in order to gain a living he had, in addition to teaching in a day school, to teach evening classes, and some of the places where these were held were so far removed from where he lived that he did not reach home sometimes until 2 o'clock in the morning; he added, it was killing work. Another gentleman has stated to me—"I certainly am not contented with the work I have to do; 10 a.m. to 9 p.m. three days a week, 10 to 5 two days, 10 to 1 Saturdays; these are my hours, and I teach no less than *eight* Science subjects. From all this, if the *results are good*, I make about £250 a year; chance of promotion none. I really feel that I am throwing the best years of my life away in useless drudgery, for I do not like (*or know much about*) the large majority of the Sciences I teach.

I think our Commissions need not go far from home to learn why we are so far behind other countries in scientific and technical education. A true instructor adapts his methods and processes of instruction to the mental capacity of each of his students; but how can a teacher who has either many subjects or many classes to teach do this? it is both a physical and mental impossibility. Prof. Fleeming Jenkin considers that, even under the most favourable circumstances, it is very difficult to obtain Science teachers capable of rendering Science as a good and mental discipline, as the teachers of the dead languages made their subjects: "for this reason Latin and Greek were dead languages, and did not change; they were taught now as they were fifty years ago; but Science changed with inconceivable rapidity, almost from day to day. What were the first-fruits of Science last year was already antiquated, and *the difficulty was* how to get a body of teachers who could follow all these constant changes at the same time they were imparting instruction in secondary schools. He did not say it was impossible, but there was a great difficulty."

(To be continued.)

ANALYSES OF BOOKS.

Colin Clout's Calendar. The Record of a Summer—April to October. By Grant Allen. London : Chatto and Windus.

We have here another of those bright, chatty volumes in which Mr. Allen is rendering the New Natural History into the language of daily life, and incorporating it with the stock notions of the public. This is a much-needed task, and the author takes it in hand not merely with a thorough good-will, but with a rare felicity.

The first interesting observation we find refers to the difference of ground selected by each of those closely kindred flowers the primrose and the cowslip. Both of course love a chalky or calcareous soil, and are scant and poor where lime is deficient. But the primrose, Mr. Allen tells us, grows chiefly on sloping banks and the sides of little hillocks, whilst the cowslip is found in abundance in the midst of level plains. This distinction is noted in an old song which we heard some thirty years ago,—the fossil fragment, so to speak, of an opera which has been duly consigned to extinction for the twofold sin of English music and English words :—

> " Primroses deck the bank's green side,
> Cowslips adorn the valley."

This simple fact will give us a good illustration of the difference between the two Schools of Natural History. The Old School would have simply noted it as a fact. The New, or Evolutionist School, brings the fact into connection with certain features in the growth of the two plants. The cowslip carries its flowers in a cluster at the summit of a stout stalk, high enough to overtop the grass at that early season of the year when it usually comes into bloom. The primrose has its flowers singly, each supported on a stalk too short and slender to bear them up above the neighbouring herbage. Hence were they to grow in the same localities the primrose would be likely to escape observation, whilst the cowslip would be seen very well. Thus the primrose haunts sloping grounds where the shortness of its stalk does not occasion concealment. Hence the difference of ground is not an arbitrary matter, but is in connection with the structural features of the two plants.

But a botanist of the first quarter of the century might and would still ask, What would the primrose suffer if it escaped observation ? If this were the case it would not be visited by bees and butterflies, and would consequently lose all the benefits of cross-fertilisation. Thus we see how in the light of Evolutionist principles such a stray fact as the favourite locality of a flower acquires a meaning, and how it in turn aids in confirming those very principles.

On the colours of flowers the author makes, in passing, some interesting remarks, from which a lesson unwelcome to the modern æstheticists may be drawn. These good people, for some reason not very apparent, have an especial love for yellow flowers. Now as any truly philosophical botanist well knows, and as Mr. Allen does not fail to point out, "the most primitive flowers are yellow; those a little above them in the scale have usually become white; those more highly evolved are generally red or pink; and the highest grade of all, the blossoms peculiarly modified for bees and butterflies, are almost always blue or purple." If we turn again to consider leaves we find a yellow colour associated with decay. And if we consider the processes by which artificial colours are manufactured, we shall find that inattention, carelessness, too high a heat, or an excessive prolongation of the action, will give other colours a yellow cast or turn them altogether yellow. Hence the worship of the sunflower and the daffodil is altogether an aberration, from which a fine feeling for the beautiful would preserve even the unscientific mind. A true æstheticism will transfer its love and reverence to red, purple, and blue flowers. We may here see, also, the reason why it is rare to find yellow and blue species in one and the same genus, or yellow and blue varieties in the same genus. We see also the reason why yellow flowers are so abundant; they are within the scope of Nature's "'prentice hand."

"The Trout Jump" is a curious medley of interesting matter, leading sometimes to difficult philosophical questions. The author writes:—"One of the great dangers, indeed, which surround the path of scientific psychology is that of being too exclusively human. Here, more than anywhere else in Science, the old Greek doctrine that man is the measure of all things, seems especially to beset us on every side." This saying may be, and is, taken in two senses, so different that the one may be pronounced nonsense and the other a profound truth. "Man the measure of all things" is commonly understood to mean that everything in the world exists with reference to man, and is arranged with a view to his interest and convenience. In the other or idealist meaning it is simply an admission of the purely phenomenal character of all our knowledge.

In the same chapter the author introduces his hypothesis that "in every case a taste for colour has been aroused in the creatures themselves during their constant intercourse with brilliant surroundings and their continual quest for brilliant articles of food."

The rule, however, that the most gaily-coloured species are flower-feeders or fruit-eaters, is not without signal exceptions, as Mr. A. R. Wallace has indeed pointed out. It fails in such groups as *Cicindela*, *Calosoma*, in the more splendid Carabs, in many of the Buprestidæ, the Longicornes, the Phanæi, among birds in the pheasants, the trogons, and in certain lizards and serpents.

In a chapter on "Catkins and Almond Blossom"—which latter he does not think pretty—Mr. Allen states—"None of our own English trees has such a brilliant spring blossom as the flowering almond." He must forget the Mezereon, whose flowers completely anticipate its leaves.

We note the remark that "you will never find a brilliant mass of heavy bloom on a strictly annual plant, and all the more massive forms are provided for beforehand by means of bulbs, corms, or tubers." This generalisation is followed up by an ungracious sneer at certain plants which are mostly admired. He speaks of "deceptive and papery flowers, like the poppies or the hand-to-mouth convolvulus, which manage to make a great deal of show at very little real expense. They spend all they have on a little gaudy colour, thinly spread out over an extremely large flat surface." The man who can speak thus of the morning glory cannot be implicitly trusted on questions of beauty.

Speaking of the "Mole at Home," Mr. Allen tells us that "wunt or wont is the good old English name of those underground animals which we now-a-days know as moles." We doubt if the name "wunt" was ever known in the north and east of England. In the most retired and old-fashioned parts of Lancashire and Yorkshire they were known as "mowdiwarps" or "mowdiwarts," *i.e.*, the animals which warp or turn the mould. The author does well to remind his readers that the common diagrams of the mole's underground habitation are "ridiculously overdone in the matter of systematic completeness."

Double flowers do not meet with Mr. Allen's approbation, and the following outburst is really unpardonable:—"Our cottage garden will not away with your modern Gloxinias, and heaven only knows what other newfangled things called by doubtfully classical names unlovelier than themselves." If the Gloxinia is unlovely, the same must be said of every other flower, and of most with a fearful *a fortiori*. And yet Mr. Allen can speak of the "ornamental value of the common wind-fertilised plants," which he himself admits bear upon them the mark of degradation and degeneracy. He says "our ordinary taste in the matter of flowers is still a trifle barbaric." What if we say that the decreasing fondness for bright colour is a mark of racial degeneracy, just like the love for bitter beverages, which seems to spring up in a nation just as dyspepsia and general debility become more common? Pure bright colours may be ill-assorted, but that is no justification for the sage greens and other dirty shades now coming into request.

We regret that we cannot carry our examination of this work any further. Though containing much that we cannot accept, it contains more that must be pronounced of exceeding interest, and no small stock of original and accurate observations.

Physical Optics. By R. T. Glazebrook, M.A., F.R.S. London: Longmans and Co.

This work forms one of the series of "Text-Books of Science" which are being brought out by the Messrs. Longman. The author in his Preface explains the division of the science of light into Geometrical and Physical Optics, the latter of which deduces the laws of the propagation, reflexion, and refraction of light from a certain hypothesis, and explains at the same time certain phenomena which geometrical optics fail to account for.

Even in this Preface the author refers to the difficulty of explaining the existence of rectilinear rays of light on the principles of the received undulatory theory. He seems almost to apologise for the simplicity of the mathematical methods made use of, which he fears "will appear long and clumsy to those who are acquainted with the differential and integral calculus." At the same time many readers will think that he has made quite sufficient demands upon their attainments.

In the first chapter we find an account of the conservation of energy, of light as a form of energy, of the Newtonian emission theory, and of the difficulties which led to its ultimate rejection. In the next chapter we have an explanation of the undulatory hypothesis, preceded by a notice of the assumed ether as the medium by which the light-vibrations are transmitted. Reasons for believing the existence of the ether are promised in a subsequent portion of the work. In the same chapter the author explains the rectilinear propagation of light,—a difficulty which Huygens, the originator of the undulatory theory, failed to overcome, and which was Newton's chief objection.

Chapter III. deals with reflexion and refraction, and explains the connexion between velocity, wave-length, and period.

In the following chapters the author treats successively of prisms and lenses; of interference; the colours of thin plates; diffraction, dispersion, and achromatism; spectrum analysis; absorption and anomalous dispersion; double refraction; the reflexion, refraction, and interference of polarised light; circular polarisation; electro-optics, and the velocity of light.

Under the last head the author discusses the hypothesis of Messrs. Young and Forbes, that the blue rays travel more rapidly than the red, and concludes that in air, as in a vacuum, waves of all colours travel at the same rate.

In treating on electro-optics he concludes that the ether and the electro-magnetic medium are the same, and that, as Maxwell puts it, "light is a series of oppositely directed magnetisations and electro-motive forces."

Mr. Glazebrook's work seems exceedingly well suited for the class of readers to whom it is more especially addressed.

The Relative Mortality after Amputations of Large and Small Hospitals, and the Influence of the Antiseptic (or Listerian) System upon such Mortality. By H. C. Burdett. Reprinted from the "Journal of the Statistical Society." London: J. and A. Churchill.

It strikes us that the long title of this little work might be improved by the substitution of "in" for "of" before the words "Large and Small Hospitals." As the title now stands a captious person might ask whether the hospitals themselves had been amputated instead of the limbs of the patients?

Apart from this trifling slip in language we find here much that deserves attentive consideration outside the pale of the medical profession. The results of the figures given show distinctly that the probability of recovery after a serious operation is greater, tangibly greater, in the so-called "cottage hospitals" than in the larger establishments. Hence Sir James Simpson cannot have been far wrong in maintaining that there exists "an inherent unhealthiness in large hospitals." The attempt to account for the difference, as one of the author's critics has done, by the assumption of a "difference in the surgical practice," is a curious plea, since it would amount to something very like an admission that the surgical skill at command of the great city hospitals was inferior to that brought to bear in the cottage hospitals. Still more curious is the assertion, by the same critic, that the "arrangements for nursing, cleanliness, and ventilation in cottage hospitals" are far inferior to those of the city hospitals. This statement is either true or false. Mr. Burdett proclaims it "entirely imaginary and contrary to the fact." If true, so much the worse for the critic in question; for there must then, on his own showing, exist in the city hospitals some cause of mischief potent enough to overpower the advantages of the superior cleanliness, ventilation, and nursing which he claims for the large establishments.

We are glad to find that the author fully appreciates the dangers of the water-closet and water-carriage system. He shows that in the original cottage hospitals earth-closets or old-fashioned privies outside the buildings were used. Now too many of these hospitals show a desire to "dabble in bricks and mortar." The new buildings are fitted with water-closets placed in the interior of the buildings, and thus sewer-gas is laid on, and conveyed almost to the bed-side of the patients, whilst drains are made, as in the majority of modern dwelling-houses, to run underneath the building. It is lamentable how completely men of science, commonly so-called, forget that a water-joint does not prevent the interchange of gases.

The results of the Listerian system in surgery are proved to be decidedly successful. The author, in pointing to the value of the work of such men as Lister, Wells, and others, asks pointedly why the highest honour ever earned by a physican or a surgeon is a baronetcy, whilst lawyers and financiers may aspire to and frequently attain peerages? Walter Savage Landor complained that the "blackest mud of the Bar and the Exchange" was "shovelled up against us in heaps."

*Der Chemismus, Magnetismus, und Diamagnetismus in Lichte mehr dimensionaler Raum-anschauung.** By RICHARD BROSCH. Leipzig: R. Brosch.

OUR readears will doubless admit that we have here to grapple with a perplexing and a thankless subject. To ignore it because it seems not easily reconcilable with the orthodoxies of modern science is contrary to our custom, and to our notions of duty. To form, as far as we are able, a fair and impartial estimate of its value, is to offend two opposite parties, each of which tacitly demands from us a benevolent neutrality. The subject has also its inherent difficulties. To judge of an attempt to consider chemism (*i.e.*, the totality of chemical phenomena), magnetism, and diamagnetism, in relation to a concept of space of more than three dimensions, a clear understanding of such space, and of what it involves, is essential. But such a clear understanding we do not possess. We do not deny that possibly to beings higher than man—the existence of which in the universe we here neither affirm nor deny—space may perhaps appear to admit of four dimensions. But this consideration does not assist us in the least. Perhaps our best course will be to quote from the work before us a popular presentation of the matter, which Herr Brosch, curiously enough, borrows from an opponent,—Professor Vogel.

"We measure space according to a threefold extension,—

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* Chemism, Magnetism, and Diamagnetism in the Light of a Poly-dimensional View of Space.

length, breadth, and depth,—and we have a clear conception of a simple body, *e.g.*, a quadrangular pillar, when we state its dimensions in length, breadth, and height. Concerning a fourth dimension we know nothing, and are absolutely unable even to conceive it. But this may possibly be due to the limitation of our senses. Let us imagine a being which, in virtue of its peculiar organisation, lived in a plane, and was incapable of recognising any object outside of such plane. This being will possess a conception of the extent of its plane in length and breadth, but, to it, the conception of depth or height—and consequently of space—would be totally wanting. All objects would become visible to this being only when they entered its plane of perception, and on leaving it they would vanish. A human finger touching this plane with its point would, *e.g.*, become visible to such a being as an oval spot at the point of contact, whilst the part of the finger standing above the plane would remain, to it, invisible. If the finger touches the plane, not with its tip, but with its side, our supposed being will obtain a quite different view of the finger, which will now appear as a long bent figure. Such a being will scarcely believe that the oval spot and the long figure proceed from one and the same object. If we remove the finger it will vanish from the sight of the supposed being, who will be unable to conceive what has become of it. Let us suppose a circle drawn in the plane ; it will appear to our imagined bi-dimensional being as a perfectly closed figure. That the circle is open above and below it will not perceive. If it wishes to go to the centre of the circle it must break through the boundary-line, and if we, from above or from below,—*i.e.*, *from the third dimension*,—put a finger in the middle of the circle without breaking through the circumference, it will, to the being in question, appear a miracle.

" It would be quite the same with us if there existed, in addition to the three dimensions of space which we perceive, length, breadth, and thickness, yet a fourth, which we do not perceive. If an object passes into the fourth dimension, it vanishes for us, and suddenly re-appears when it enters into our region of perception. It is even conceivable that a hollow ball, which to us appears as a body closed on all sides, is open in the fourth dimension, just as the circle which to a bi-dimensional being appears completely closed, is open above and below.

" To a bi-dimensional being the tying an ordinary knot on a piece of string free at both ends, would appear inconceivable, as for this purpose one end of the string must be lifted up out of the plane in order to be passed over and then under the other part of the string, whilst a man, with his conceptions of height, breadth, and length, at once understands this operation.

" On the other hand, we are not able to tie a knot in a string whose two ends are connected so as to form a ring without first opening the string. But if we suppose a fourth dimension, and beings which can act in it, it is conceivable that such beings may be able to tie a knot on a ring-shaped string."

This is, perhaps, as clear a representation of the hypothesis of poly-dimensional space as can be obtained without the aid of transcendental geometry.

The author propounds a hypothesis which he endeavours to follow out to its physical and chemical consequences. It is as follows :—"Our tri-dimensional world, in as far as it is composed of ponderable matter, consists of poly-dimensional atoms, arranged in a tri-dimensional manner."

This hypothesis compels us to the conclusion that every atom possesses several magnetic axes, situate in various fixed directions in or upon it. Those only which lie with both their poles in tri-dimensional space are permanent and incapable of being induced. All the others are ordinarily inactive, but owe their origin to an inductive action. According to the position of the atom sometimes one and sometimes another of these axes comes to lie in tri-dimensional space, and furnish then permanent atom-magnets.

This hypothesis, further, according to the author, serves to explain how one and the same atom, in different combinations, can appear with a different atomicity.

But, admitting that the hypothesis, if fully followed out, may throw a new light upon a multitude of phenomena, we have still to ask what are its foundations? For, if no fourth dimension exists, the light thrown by the new hypothesis will be a Will-o'-the-Wisp,—an *Irrlicht*. We must ask, then, for a perfectly distinct and decisive proof of the existence of this fourth dimension. There have been produced, we are told, certain phenomena, such as the tying of a knot on a closed string, the passing of two wooden rings through each other chain-fashion, the passing of a ring upon a pole at either end of which there are projections whose diameter exceeds that of the ring, the placing of a ring upon a man's arm whilst he holds his hands clasped together, &c. Admitting all this without discussion,—for which, indeed, our space is wholly insufficient—there remains a difficulty which Herr Brosch has not ignored. Whether he has succeeded in meeting it is another question.

Supposing the above-mentioned phenomena verified, are we to infer, with the late Professor Zöllner, and with our author, the existence of a fourth dimension, and of beings capable of acting therein? Or are we to assume, with not a few believers in the reality of the phenomena, that there exist superhuman beings capable of abolishing temporarily the continuity of an iron ring, of a wooden pole, or of a human arm, and then of restoring it to its former condition? We do not find here any answer which compels our belief.

That the work before us is suggestive and that it is worthy of a careful study we gladly admit. But we seek to know whether the fourth dimension is a *vera causa* before tracing out its possible consequences.

The Land Junction of Great Britain and Ireland by an Isthmus at the Mull of Cantyre. By J. CHARLES KING, Engineer, &c. London: R. H. Squire.

WE have here in a brief pamphlet a proposal of startling magnitude. The author proposes nothing less than an artificial isthmus running from Torgor Point on the north-east coast of Ireland to the south-western extremity of the Mull of Cantyre, thus uniting Britain and Ireland, and converting the Irish Sea into a land-locked bay. The project cannot be pronounced other than bold. But it is certainly practicable if the Legislature grants permission, and if the needful capital—which will not be trifling—can be obtained. The water way to be built up is, according to the author, 19 miles in width, about 200 feet in depth near either coast, but 474 feet deep in the middle. The current running from the north-west into the Irish Sea is given on the author's illustrative chart as six knots per hour in the middle and at the Irish end of the proposed embankment, but as "of great strength" near the Scottish coast. Still these difficulties are doubtless not beyond the resources of modern engineering. It is mentioned that there are at both ends eminences from which the materials could be obtained in sufficient quantity, and could be run down to the sea by gravitation alone. Near the Irish coast there are, indeed, certain hills ranging from 980 to 1300 feet in height, which would yield almost a sufficiency of rock, &c., as the proposed isthmus is to be only about 100 yards in width. The author's estimate of the expense of the undertaking is about two millions sterling. We must not forget, however, that the actual cost of such great undertakings generally falls out very much higher than the original estimate. Perhaps if we say £5,000,000 we shall be on the safe side. The time required for the completion of the work is stated as from two to three years.

As regards the cost the author makes some very important suggestions. He does not propose an outlay of national funds, and a consequent increase of taxation. For labour he proposes to make use of the able-bodied convicts, now uselessly or harmfully employed in prisons. He estimates that some thirty thousand such men could be put to the work at once, and he thinks that "the gain to the state by closing their prisons in and near London alone would yield valuable ground worth many thousand pounds for yearly rental."

But, on the other hand, the thirty thousand criminals would require to be housed, fed, and adequately guarded. For these purposes at least two temporary prisons of great size would be needed, one in Ireland and one in Scotland. The scene of operations on each coast would need to be invested by a cordon of troops, and to prevent escape by sea a proper and efficient blockade would have to be maintained along both the northern and the southern coast of the isthmus, especially as it approached completion. Nor do we see that the ordinary prisons, in London or elsewhere, could be permanently closed, for, without considering the many convicts who would be manifestly unfit for such labour, what would have to be done with the able-bodied ruffians when the work was completed?

Mr. King's method of raising the necessary funds seems to us very judicious. He proposes that "the tolls and land-rentals of so important a position as the isthmus would become for a new city, might be hypothecated by a paper currency issued under State guarantees for this special object." This plan was, if we remember rightly, adopted for the erection of the Jersey meat-market and proved most successful.

We must now glance at some of the more formidable difficulties in the way. The first consideration is the interference with navigation. A glance at the map shows us that the sea route from all ports on the west coasts of England, the south-west of Scotland up to and including the estuary of the Clyde, and the east coast of Ireland, would be greatly interfered with. The coasting trade between all those parts and the west of Scotland or the north of Ireland would be obliged to seek another channel. Without having any statistics at hand we should conclude that the greater part of the commerce of Glasgow with Canada, the West Indies, the United States, &c., passes along the North Channel between Ireland and the Mull of Cantyre. A considerable share of the trade of Liverpool and of Belfast will take the same direction. To meet this difficulty Mr. King proposes to widen the Canal of Crinan, and to cut another through the Isthmus of Tarbert. These projects would involve a certain outlay, and hence a toll would be necessitated. A ship-owner in any of the ports concerned would say with justice: "At present I have a comparatively short and simple route provided by nature. You block it up and compel me to take a longer and more intricate track, and for so doing you charge me a toll!" Hence we conclude that on mere commercial grounds the project will meet with warm opposition from the sea-ports in question.

There is another difficulty to be encountered. The current flowing into the Irish Sea through the North Channel is, as everyone knows, and as the author expressly mentions, a part of the Gulf Stream. To its action the south-west of Scotland, the Isles of Bute and Arran, the shores of the Frith of Clyde, certain parts of the north-east of Ireland, and even the coasts of Cheshire, Lancashire, and Cumberland, owe their exceptionally mild climate. The vegetation of Bute and Arran reminds us of the Channel Islands, the Scilly Isles, and the most sheltered spots of the coast of south Devon. Everyone must know that the districts of Chester, Warrington, Lancaster, Ulverstone, &c., are often enjoying open weather when the midland counties, even Kent and Sussex, are covered with snow. But supposing this influx of the Gulf Stream cut off by the proposed isthmus, there is every probability that the temperature of these districts would be reduced to that which prevails at corresponding latitudes on the eastern side of Britain. Bute, Arran, Helensburgh, &c., would lose much of their attraction for health- and pleasure-seekers.

It is also very possible that the fisheries on the north-western coasts of England and on the south-west of Scotland would suffer, *e.g.*, the Lock Fyne herring fishery.

On the other hand, the land junction would, in the opinion of the author, lessen the depth of the Irish Sea, "serving to aid the natural drainage of the adjacent coasts, and make the marsh-land of the west (?) coast of Ireland capable of the highest forms of cultivation."

Another advantage which suggests itself is that at present in case of war an enemy's fleet might enter the Irish Sea and do incalculable damage to the wealthy and practically undefended towns of our western coasts with but little fear of being intercepted. Were the proposed isthmus an existence, such a fleet would almost inevitably find its retreat to the south cut off.

What may be the general opinion of the nation should this project take a more definite shape, we can scarcely venture to foretell. But we suspect that in Ireland and in certain parts of England and Scotland, it will meet with but little support.

Journal of the Royal Microscopical Society. Containing its Transactions and Proceedings, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c. Edited by Frank Crisp, LL.B., B.A., one of the Secretaries of the Society, with the assistance of the Publication Committee, and A. W. Bennett, M.A., B.Sc., F. Jeffrey Bell, M.A., S. O. Ridley, M.A., and John Mayall, Junr. Series 2, Vol. II., 1882, pp. 941. London and Edinburgh: Williams and Norgate.

The current volume of this valuable periodical has just been issued. It contains first of all sixteen original communications read at the meetings. The value of these is greatly increased by the publication in another part of the book of the discussions following the reading of the said papers, a course which has always been the practice of the Royal Microscopical Society.

As may be expected from the extensive use of the microscope as a means of reseach, the papers are of a varied description. Those on biological subjects comprise: "Further notes on the British Oribatidæ," by A. D. Michael, F.L.S. The strange forms of these minute creatures, so accurately figured by the author in this and many preceding communications, must attract the attention of the most casual reader. Mr. Michael is preparing the results of his observations for publication on a more extended scale than is afforded by the limits of an occasional paper. Dr. John Anthony's communication "On the Threads of Spiders' Webs," places on record some interesting facts respecting the structure of the web of *Epeira diadema*. Dr. R. L. Maddox contributes two papers, "On some Micro-Organisms from Rain-water Ice and Hail," and "On some Organisms found in the Excrement of the Domestic Goat and the Goose." "Note on the Spicules found in the Ambulacral Tubes of the Regular Echinoidea," by Professor T. Jeffrey Bell, M.A., one of the editors of the Journal; and "On the Bacteria of Davaines Septicæmia," by G. F. Dowdeswell, M.A.; note by F. Kitton on Rev. G. L. Mills's paper on "Diatoms in Peruvian Guano"; "Plant Crystals," by Dr. Aser Poli, complete the biological portion.

Among apparatus described are a "New Growing or Circulation Slide," by T. Charters White, and "A further Improvement in the Groves-Williams Ether Freezing Microtome," by J. W. Groves. Mr. Stephenson's* communication on "Mounting Objects in Phosphorus and other Dense Media," and Dr. B. Wills Richardson's, "On a Simple Process of Imbedding Tissues for Microtome Cutting," complete the papers on manipulation.

Two portions of a most valuable optical paper by Professor Abbe, of Jena, entitled "The Relation of Aperture and Power in the Microscope," appear in the present volume.

The address of the President, Professor P. Martin Duncan, is chiefly occupied by an admirable exposition of recent optical discoveries. Calling attention to the small number of papers received by the Society, he reminds his readers that a very large number of observations principally worked out by means of the microscope have been recorded during the past year in the transactions of other societies, and that the microscope is always being carried into new fields of research. It promises to be of great assistance to the chemist, and while but a few years ago no one thought of including it among the essential tools of the geologist, it is extensively applied to the examination of rocks, and most valuable results have been brought to light by its aid.

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* Journal of Science, vol. iv., p. 376, 1882.

He congratulates the Society that whether as regards theory or practice—the optical and mechanical or the observational part of our science—there has never been a time when so much evidence could be produced of solid progress as now.

The "Summary of Current Researches," which occupies the greater part of the volume is a most valuable compilation, and the patience and energy of the editors in collecting and preparing so complete an abstract of biological and microscopical research cannot be too highly commended. Preference is as a rule given to foreign papers, for the reason that such are not very accessible to English readers, while memoirs published at home need little beyond a reference to the place where they may be found, but even here very useful abstracts are given.

The index and table of contents are both very copious and admirably arranged, so that a subject sought for may be traced out with the minimum of trouble. In addition a very complete list of books and papers, British and foreign, relating to biological and microscopical subjects is given.

With each separate number appear a valuable series of tables compiled by Mr. J. W. Stephenson, F.R.A.S. They will be found very useful to microscopists. They include the respective values of "numerical and angular aperture" in air, water, and oil; the conversion of British and metric measures; corresponding degrees in the Fahrenheit and Centigrade scales; and, lastly, a table of magnifying powers.

Longman's Magazine, No. III., January, 1883.

None of the articles in the issue before us deal with subjects upon which we may claim a right to adjucate. To a few incidental passages we may, however, refer. Thus, in the serial story, "Thicker than Water," we read: "The dog is to be won by fear, but the cat never—a circumstance which, if there were no other urgent reason for it, would always place the cat above the dog, in my opinion." "The New Pygmalion" is a clever allusion to a trial which has enriched the lawyers, and has, to the general public, proved only less wearisome than that of the "Claimant."

That strange ghost story, "The Lady's Walk," comes to a conclusion. Evil is averted, but not by the mysterious spiritual guardian, whose part thus becomes little better than that of a supernumerary.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE NICETY OF BIRDS.

To the Editor of the Journal of Science.

Sir,—The following facts will perhaps not be unwelcome to that numerous portion of your readers who take an interest in animal psychology:—

A canary-bird belonging to an acquaintance is exceedingly fond of bathing. As he makes a considerable slop in so doing, the lady to whom he belongs placed his cage in the kitchen till he should have taken his bath; but the bird on such occasions invariably refused to enter the water till he was brought back into the breakfast parlour.

Another canary had been accustomed to have his bath in a cup of black glass. It having been broken, a common earthenware cup was substituted; but the bird refused to bathe till a glass vessel (this time colourless) was obtained.

A large grey parrot belonging to a neighbour of mine is much offended if his cage is not cleaned out regularly. On one occasion, having been neglected for nearly a week, he fell to work, and with beak and feet contrived to throw all the sand, fragments of food, &c., which had accumulated at the bottom of the cage, down upon the carpet.

These facts show that birds have a sense of order, neatness, and even elegance, and that their whole nature is not absorbed in the gratification of their physical wants.—I am, &c.,

H. M.

"FARINI'S MISSING LINK."

To the Editor of the Journal of Science.

Sir,—Having paid a visit to this marvel I must confess that I see little evidence for its being a form connecting man with any of the anthropoid apes. The large size of the head tells decidedly against such a hypothesis. The toes seem, indeed, more easily and widely separable from each other than in modern Europeans; but this is a common characteristic in the Far East, where, *e.g.*, carpenters will often hold a board steady with their toes, whilst their hands are occupied with some tool. I do not see that, in the specimen now under exhibition at the Westminster Aquarium, the great toe is more fully opposable to the other toes than in human subjects. The growth of the hair will also seem of little importance if we reflect that among certain tribes —*e.g.*, in Australia—the backs of young children are densely covered with hair half an inch in length.—I am, &c.,

A Graduate.

THE "ADVANCEMENT OF MEDICINE BY RESEARCH."

To the Editor of the Journal of Science.

Sir,—When the Society for the Advancement of Medicine by Research was constituted Sir William Jenner is reported to have said that "there was no desire on the part of those who had worked in the formation of that Association to evade the law; there was no desire on their part to ask for a repeal of the law, or even for any modification of it."

Commenting on this statement, you very justly declared that if those words really limit the objects in view, "we scarcely see that the Association has any well-marked *raison d'être*." But now I read in the medical papers of "material assistance on behalf of harassed experimentalists whose efforts in the cause of discovery are at present hampered by the miserable restrictions imposed by the Vivisection Act." This sounds healthy, but it is sadly out of keeping with Sir William Jenner's opening address. —I am, &c.,

Graduate.

THE ELECTRO-MAGNETIC THEORY OF THE UNIVERSE.

To the Editor of the Journal of Science.

Sir,—You have doubtless met with some notice of the memoir contributed to the New York "Journal of the Telegraph," by H. Raymond Rogers, M.D., who considers "magnetic inter-action" as being the "key to the whole subject of universal force and to the methods of its operation."* Without going more closely into the details of this theory it seems to me very defective, as throwing no light whatever upon either the origin of the planetary bodies, or the power which set them in motion. It presupposes, *e.g.*, the sun and the planets made and and endowed with magnetic force, and then set in motion, gravitation being thus generated. Dr. Rogers speaks of "the motions of the celestial spheres, due to a *primum mobile* wholly undemonstrable." Here, therefore, we have the greatest cosmic facts either relegated to the realm of miracle or at least left utterly unexplained. I am surely warranted in asking whether Science is benefitted by such a hypothesis?—I am, &c.,

A Lucretian.

AN APOLOGUE.

To the Editor of the Journal of Science.

Sir,—Perceiving that you do not espouse the views on higher education just now fashionable in your country, I venture to send you a short apologue which may convey a lesson:—

There were two nations, each in want of gold. The one, which we call A, set to work seriously to mine for gold, and to search for it in ores and furnace-products.

The other nation, B, did nothing of the sort. But instead it founded an assay-office in every village and a mint in every town, so that all existing gold might be "hall-marked," and might bear the royal imprint. Which nation increased its stock of gold?

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* Our present issue contains an article which takes views not very dissimilar from those of D. H. R. Rogers.

The interpretation is not hard. The "gold" is trained intelligence. The two nations are mine and yours. Your mints and assaying offices are your examining bodies. Our gold-mines are our schools of research.—I am, &c.,

F. Meyer.

[The case is worse against us than our correspondent makes it. The assayer, though he cannot increase the quantity of bullion, yet distinguishes correctly fine gold from base metal. Our mental assayers reject the finest gold along with the pinchbeck, and "pass" the 8-carat articles.—Ed. J. S.]

POPULAR INSTRUCTION.

To the Editor of the Journal of Science.

Sir,—You have often remarked the ignorance of the cultivated classes, and even of public instructors, concerning the natural sciences. I met with a striking instance of this the other day. Taking up by chance a periodical addressed to young ladies, I found in one of the articles a slug referred to as an "insect,"—not merely once, but repeatedly! If such darkness is in the teachers, what is likely to be the state of the taught?—I am, &c.,

"Thorough."

NOTES.

Our attention has been called to the subjoined paragraph in the "Secular Review." If a simple record of facts it is of capital value, as proving that some dogs have a conception of number at least up to twelve, which is more than can be safely said of some human races:—"A lady friend of mine has a bull bitch that is very wise, and is a Neo-Malthusian. She one day gave birth to fifteen pups. Counting her offspring, and then her feeding apparatus, she saw at once that there was a surplus population. Fifteen in family; food supply for only twelve; no workhouse for the three little extras. The venerable Malthus could not have solved the difficulty more promptly. Counting up her teats once more, and also her offspring, she selected three and put her sharp teeth through their brains, and by their prompt and painless extinction made a manageable and happy family."

The "Journal of the Royal Microscopical Society" for December, 1882, contains a translation of a paper giving a full account of the methods of microscopical research in use at the Zoological Station at Naples. The collection of formulæ for killing, hardening, and preserving is very extensive: the properties of the various solutions are discussed at considerable length, and full manipulative details given. Mounting in balsam seems to be the mode of preservation most in favour at Naples, and the whole series of processes employed aim at getting rid entirely of the water contained in the tissues, and replacing it with a preservative medium. When the absolute permanency of balsam preparations is taken into consideration, and also the fact that specimens from the establishment are transmitted to all parts of the world, there is a good reason for the adoption of balsam-mounting almost to the entire exclusion of other methods. The preparations of marine animals issued by the Zoological Station are well known to histologists for the perfect manner in which the processes of staining and permanently mounting are carried out, and also for their great biological value. The paper is the natural outcome of an institution which has no secret processes to withhold, and whose only object is research and the widest possible diffusion of the results. The translation will prove of the greatest value to English histologists, and furnishes another of the numerous instances in which the Royal Microscopical Society has placed translations of important foreign papers in the hands of its fellows as speedily as possible after their issue.

A museum is to be erected in connexion with the Owens College, Manchester. We hope the promoters will avoid the common error of expending the bulk of their funds on bricks and mortar, and having to depend upon chance donations for the contents of the establishment.

M. Boussingault ("Comptes Rendus") gives determinations of nitric acid and of ammonia in snow water from elevated points in the Alps. That from Neige du Velan (3760 metres) showed —nitric acid, 0; ammonia, 0·10 m.gr. per litre. Glacier of Kaltenwasser (3560 m.), and that of Palu (3000 m.), no nitric acid and no ammonia.

In a paper read before the Society of Arts, Mr. W. A. Gibbs, the inventor of the agricultural drying machine, speaking of the treatment he has received, said :—"If I had been a timid man, I should have been daunted ; if I had been a poor man, I should have been ruined ; if I had been a sick man, I should have been killed by this injustice."

The past autumn has been one of the driest on record in the north of Norway,—a contrast to the floods which have prevailed in England, France, Germany, and Italy.

A herd of the caaing whale (*Phocena globiceps*), estimated at near 20,000 head, has appeared among the Loffoden Islands. About 1500 have been caught in a single fjord.

Dr. Herdinger ("Deutsche Medic. Zeitung"), in a recent official report on deaf-mutism, shows that the offspring of consanguineous marriages afford 10 per cent of the cases, in addition to 5 per cent of the total cases, of blindness, and 15 per cent of those of mental disease.

Prof. T. Rupert Jones, F.R.S. ("Geological Magazine") sums up the causes of the sudden destruction of large numbers of marine animals. The principal are—efflux of fresh water from the land, volcanic agency and earthquake waves, hurricanes, excess or deficiency of heat in shallow water, diseases, and lightning.

Dr. Tuke, in a Lecture lately delivered before the Edinburgh Health Society, remarked that one of the great causes of overstrain in early youth was the vicious system of offering prizes for competition. It deflected the mind of the child from the main aim and object of its study, and often defeated the object which it was hoped to obtain.

M. E. Heckel (who must not be confounded with Prof. Ernst Haeckel of Jena) still denies the action of insects as factors of brilliant colouration in flowers. He brings forward no new facts, but says—"I persist in admitting [he should say in maintaining] that fecundating insects are not in any manner the cause of the luxuriance of the floral system in some Alpine species." He seeks the cause in the solar radiations, which are more intense on the mountains than in plains.

At a recent meeting of the Midland Institute of Mining Engineers the new process of getting coal with lime-cartridges, in place of gunpowder, dynamite, &c., was discussed. It has given unbounded satisfaction in Belgium, Austria, and in many mines at home, the percentage of round-coal being more than doubled, whilst danger to the men is entirely excluded. The only failure was at Aldwarke Main, where the coal, being elastic, gave way without being ruptured.

Prof. O. Wendell Holmes has resigned the Chair of Anatomy at Harvard University, which he has held for thirty-five years. He intends, it is said, to devote his time to literature!

The annual yield of gold from the mines of French Guayana is about 2500 kilos.

According to Langer (" Kaiserlich Akad. der Wissensch.") the fat of children contains 67 per cent of oleic acid, 28 of palmitic acid, and 3 of stearic acid. In the adult the oleic acid has risen to 89 per cent, whilst the palmitic and stearic acids have fallen respectively to 8 and 2.

The poison of the rattlesnake, according to Dr. Ott (" Gazette Hebdomadaire "), kills animals by arresting the movements of the heart, and producing a considerable reduction of the arterial tension.

According to Dr. Perardon the lower animals are less susceptible to the action of resorcine than is man,

A M. Gourdin writes to the " Gazette de Cambrai " that the lightning fell three times upon a tree by the roadside from which he was only eight paces distant. He lay down on the ground, and covered himself with a woollen umbrella. The tree was cut up, and he was " coiled round with flames and completely electrified." He considers that he owes his safety to his presence of mind and his woollen umbrella.

In New Mexico there is another species of *Heloderma* allied to the poisonous lizard, *H. horridum*, recently brought to the Zoological Gardens. The species in question, *H. suspiosum*, is found by Prof. Snow not to be poisonous.

According to M. Hervé-Mangon the annual production of milk in France would form a stream of a metre in width and one-third metre in depth, flowing for the entire year at the speed of 1 metre per second.

Prof. H. A. Howe (" Kansas Review of Science ") concludes that the comet of last autumn is not that of 1843, and that there is no danger of its falling into the sun at any time.

M. Risler ("Comptes Rendus") finds that the wheat plant never grows on any day when the temperature of the air in the shade does not, for some hours at least, exceed 43° F.

Mr. D. Eccles assumes that matter and its states are an illusion having no existence outside of mind, which is the only real existence.

M. Ch. Brongniart ("Comptes Rendus") describes a fossil orthopterous insect discovered in the coal-beds of Commentry. The insect in question, *Titanophasma Fayoli*, makes a near approach to the living Phasmidæ, and is 10 inches in length.

M. L. Vaillant ("Comptes Rendus") describes *Eurypharinx pelecanoides*, a deep-sea fish, caught off the coast of Morocco at the depth of 2300 metres. This fish is of an intense black colour; its locomotive organs are quite rudimentary. The enormous mouth and pharyngeal cavity form, as it were, the aperture of a funnel, of which the body constitutes the stem. Digestion is supposed to be effected in the mouth.

M. M. Mendelsohn ("Comptes Rendus") finds that, for a given weight, the mechanical work of a single contraction of a more excitable muscle is greater than that of a muscle whose excitability is normal. The latter, however, is less rapidly exhausted.

M. C. de Merejkowsky has presented to the Academy of Sciences a study on the *Suctociliata*, a group of Infusoria intermediate between the *Ciliata* and the *Acineta*.

MM. G. Pouchet and J. de Guerne ("Comptes Rendus") have studied the Malacological Fauna of the Varanger Fjord. The character of this fauna is distinctly Arctic. Of 94 species of mollusks, 63 are common to Greenland; 55 to Spitzbergen; 42 to Nova Zembla and the Kara Sea; and 41 to Behring's Straits.

A being is now under exhibition at the Westminster "Aquarium" which its owner, Signor Farini, asserts is "the 'missing link' which the late Mr. Darwin was unable to discover in the chain of evidence connecting the direct relationship between man and the monkey. This link assumes the form of a female child, about six or seven years old, said to have been discovered in Burmah. She looks, and is, a very intelligent child, who, although only a few weeks in England, speaks and understands English with ease. The head, which is set well upon the shoulders, and is in size out of all proportion to her body, is thickly covered with hair, which grows down to the eyebrows, which overarch eyes of extraordinary depth and penetration. The arms, legs, and body are covered with thick hair at least an inch in length. In support of Mr. Farini's theory that the little creature is but half human, it may be stated that she has a double row of teeth in the upper jaw; that she can in the hollow of her cheeks stow away food to be eaten hereafter, as the monkey does in his 'pouches'; and that the fingers and toes bend backwards and forwards to the same extent, and with equal ease." Concerning the above description, quoted from a contemporary, we must remark that Darwin did not seek to discover a link between man and the anthropoid apes. The possession of a double row of teeth in the upper jaw is no more a simian than it is a human characteristic, and proves nothing. It is incredible that a creature lower in intelligence than man should learn in a few weeks to speak and understand English with ease.

According to "Light," Lord Ingestre took a book at random from the shelves, and holding it closed behind his back asked Didier to read the first lines on page 27, and Didier succeeded in so doing.

In an address delivered by Mr. Ivor MacDonnell, and reported in "Light," we regret to find the following misuse of language:—"The general public laughed heartily at *biological* displays."

We at one time suspected Spiritualists of having "Anti-Vivisectionist" leanings. We are glad therefore to note that "Light," in accordance with the expressed wishes of its principal supporters, has declined to open its columns to a discussion of the Vivisection question. This looks healthy.

The following clause in the proposed new tariff of the United States may be pronounced a somewhat one-sided tax on knowledge:—"Philosophical apparatus and instruments forty per centum ad valorem; provided, that any philosophical apparatus and instruments imported for the use of any society incorporated for religious purposes shall be subject to a duty of only fifteen per centum ad valorem." We must confess ourselves unable to see either the justice or the utility of the addition impost of 25 per cent thus thrown upon non-sectarian colleges and upon societies incorporated for purely scientific purposes.

According to Mr. S. Lockwood ("American Naturalist") the male of *Lepus Bairdii* has large teats and udders, and suckles its young ones.

Prof. Ferrier, F.R.S., is about to bring out a new and enlarged edition of his work on "The Functions of the Brain."

M. Proust, in a communication to the Academy of Medicine (October 31st, 1882), makes the startling assertion that there are still in France 219,270 houses without a window.

We are glad to learn that the American journal "Science" is about to be revived. Mr. S. H. Scudder, the eminent entomologist, is the appointed editor.

We understand that the Chemistry Class-room at the new

City Schools is so constructed that the voice of the master will be scarcely audible.

A meeting was held on the 20th ult. for the purpose of organising a national fish-culture association.

Prof. L. Miall delivered a Lecture on the 21st ult., at the London Institution, on "Dominant Forms of Animal Life."

Dr. H. R. Rogers refers gravitation to electricity, and maintains that "the *prime factors* in the problem of Universal Force are: (1) The motions of the celestial spheres due to a *primum mobile* wholly undemonstrable; and (2) *the magnetism inherent in these spheres*."

We are very sorry to learn that the proposed meeting of the British Association in Canada meets with objectors. We might reasonably hope that men of Science would rise above that narrow, parochial spirit, which is one of the gravest defects of the English national mind.

We were mistaken in announcing the death of Prof. Palmieri, of the Vesuvius Observatory. The death of a nephew and namesake of the illustrious seismologist had given rise to a false report.

A subscription for the erection of a monument to Darwin has been opened at Paris, under the auspices of the Academy of Sciences. The Committee, however, make the reservation that their act does not imply any appreciation of "the general doctrines, scientific or philosophical, of the illustrious defunct."

It is with deep regret that we announce the unexpected death of our friend and contributor, Mr. Robert Ward, of Newcastle-upon-Tyne. The deceased gentleman had been engaged in preparing for publication the reminiscences of his distinguished relative, Bewick. The work was to have been illustrated with a selection of engravings from the original blocks. He enjoyed in this task the cooperation of Miss Bewick, who, we hope, will be able to complete the undertaking.

Dr. L. Kretzschmar (*Botanische Zeitung*) shows experimentally that the reagent used by Loew and Bokorny for distinguishing living from dead protoplasm (*i.e.*, a very dilute alkaline solution of silver) acts alike with both, and that the alkali alone, even in the absence of the silver, kills the protoplasm.

Dr. Schadenberg, on an exploring journey in the southern Philippines, has met with a new species of *Rafflesia*, the flower of which measures 30 inches in diameter. Its odour is unpleasant.

Twentieth Year of Publication.

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THE

JOURNAL OF SCIENCE.

MARCH, 1883.

I. THE BRAIN THEORY OF MIND AND MATTER.*

By Constance Arden.

> "The Vedic poets dimly recognised their Gods as only symbols of the ultimate power that manifests itself in the world,—the Atman or Self—the Self of all things—the Self in which each individual must find rest."—Max Müller, *India, What can it teach us ?*

It is not seemly that an artist who has painted any part of a picture, even though his share be confined to the back-ground or the accessory figures, should present himself as a critic of the completed work, nor that one member of a Beaumont and Fletcher partnership should undertake to point out the merits and defects of a jointly-written drama. Yet, if the picture or the play deals with some forgotten legend, or shadows forth some unfamiliar truth, nothing can be more natural than that its meaning should be clearly and publicly set forth by one of its fashioners. What is permissible in the field of art may become imperative in the region of scientific verity, where the substance of the work is everything, and the style nothing, save as a more or less efficient vehicle for the conveyance of ideas to the understanding. I need therefore not apologise for this brief exposition of the main thesis contained in a *brochure* to which I am one of the contributors.

---

* What is Religion ? a Vindication of Free Thought, by C. N. Annotated by Robert Lewins, M.D. With an Appendix on Hylo-Idealism ; or, the Brain Theory of Mind and Matter, the Creed of Physics, Physic, and Philosophy. London : W. Stewart and Co., 41, Farringdon Street, E.C.

The standpoint of Hylo-Idealism cannot be wholly unknown to readers of this Journal, since from time to time letters and articles on the subject, by Dr. Lewins and myself, have appeared in its pages, some of which are reprinted in the tractate before me. At the base of the whole philosophy lies one fact adumbrated by many,* realised by few, but contradicted by none; for those who attempt to disprove it invariably mistake the object of attack, and manfully hew away at the shadow of the tree, while its roots still strike deeply into the earth, and its trunk and branches tower and wave above these would-be assailants. No one has ever been able to deny, though many have fancied that they were denying and confuting, the proposition that Man is the maker of his own Cosmos, and that all his perceptions—even those which seem to represent solid, extended, and external objects—have a merely subjective existence, bounded by the limits moulded by the character and conditions of his sentient being. It is admitted by all whose opinion is of any value that colour exists only in relation to the eye, sound to the ear, touch to the skin, odour to the nose, and taste to the mouth. Nor has anyone yet asserted that (in the case of man and of the higher animals, our data not enabling us to deal with possibilities of sensation in lower forms of life) these elementary feelings can be generated in the absence of a percipient brain, which focuses converging rays of sense from all parts of the body, and unites them into the white light of consciousness. But the most rigorous analysis can extract from the "external" world nothing save colour and form, sound which developes into music or degenerates into discord, tastes, and odours, with harmonies and dissonances of their own, and impressions of touch, whence arise those ideas of solidity and extension which to the unreflecting seem conclusive proofs that the Universe must at least possess tangible objective reality, even though its visible, odorous, and sapid complement be but a brain-created panorama. In these days of physiological research and of popular scientific instruction it should be clear to any person who takes the slightest trouble to think about the matter that the phenomena of all the senses possess precisely the same degree of validity, and that this validity is purely internal and individual. "The whole universe of things and thought is thus only an *automorphosis*, each Ego being to itself, as Protagoras postulated, the measure and standard of all existing things, of all thought and objects of thought whatsoever." * The profound Protagorean maxim is frequently attacked, with complete misapprehension of its import, by philosophers and scientists of the shallower sort, who appear to suppose that it implies an ignorant disdain of all existence which is not human, instead of a recognition of the solidarity between Man and the Universe, animate and inanimate, sentient and senseless.† A more than usually amusing example of this misconception is afforded by that popular writer Grant Allen, in a recent work reviewed last month in the "Journal of Science." It is evident, from his patronising approval of wind-fertilised flowers, and his vehement attack upon the poppy, the convolvulus, and the "unlovely" *Gloxinia*, that if the mind of man in general cannot claim to be the "measure of all things," yet the mind of Mr. Grant Allen in particular conceives itself well entitled to that proud pre-eminence.

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* Such adumbration may be remarked even in the writings of so staunch a religionist as Cardinal Newman. In a passage from the "Grammar of Assent," quoted in the current No. of the "Westminster Review," he says, "Everyone who reasons is his own centre, and no expedient for attaining a common measure of truth can reverse this truth." Again, "There is no ultimate test of truth besides the testimony borne to truth by the mind itself." The Reviewer well observes that the Cardinal's theory is indistinguishable from that of Protagoras.

Let us see in what sense every man is, to himself, the standard by which "all thought and objects of thought" must be tested and classified. A colour-blind person has perceptions which are quite as true as those of the most subtly discriminative landscape painter; but the retinal "colour-box" of the former has no tints corresponding with the green and crimson which the latter differentiates into a thousand delicate gradations. The unknown force which we call Light, and picture intellectually as a series of ethereal vibrations, without thereby advancing a step towards the knowledge of its essential nature, acts impartially upon the retina of both. That its internal manifestations are diverse depends upon the special organisation of the two individuals. One has, and the other has not, colours in himself. Light, then, is not a simple gift from the sun, but is a product of mental metabolism, which fashions all that we know of brightness and darkness. Beyond this there is practically nothing, for our wildest imagination cannot overleap the boundaries of Self, and depict an invisible cause of Light. The very terms which we must use, if we wish to imply that such a thing is possible, demonstrate by their contradiction its impossibility. But supposing for a moment that this inconceivable power could be gained, its possessor would probably perceive nothing which could distinguish the origin of light from the origin of sound or odour. It is well known that one and the same cause, such as an electric shock or abnormal distension of the capillaries, will produce different effects in the various organs of sense. The eye may see flashes of lightning; the ear may hear the sound of a gong; the skin may feel acute pain; or rather the brain may transmute identical stimuli, conveyed to it by different channels, into results which are not only dissimilar, but actually have nothing in common. Since the dissimilarity does not come from without, it must come from within; therefore we arrive at the conclusion that the world is made inside, and not outside, the cerebrum. Although rejecting that Absolute Idealism which will deny the existence of aught that is corporeal, even of the sensifacient hemispheres and the sensiferous nerves, we are forced to accept that Relative Idealism which declares that the only Cosmos known to man, or in any way concerning him, is manufactured in his own brain-cells. Far more truly than the painter "creates" the picture from elaborated materials already provided for him by "Nature," every one of us creates Nature herself, in a tiny cerebral studio, without pencil and without pigment. We make the mountains, and the sea, and the sun himself; for sunshine is nothing if not visible, and if there were no eye and no brain there could be no sunshine.

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* What is Religion? p. 38. Appendix No. 1.

† Even J. S. Mill, who in his definition of Matter as a "permanent possibility of sensation" virtually adopts the Auto-centric position, inconsistently condemns the axiom of Protagoras as "a scandal to philosophers," evidently quite misapprehending its real import.

These truths are so self-evident that it seems superfluous to quote authorities in their support. It may, however, not be altogether useless to refer my readers to the recent translation of Kant's "Critique of Pure Reason," by Professor Max Müller, and also to a very able though not perfectly consistent article on the great German philosopher in the current number of the "Edinburgh Review." The following sentences from the latter are especially applicable:—"Kant's whole system throughout is nothing but the question underlying all philosophy, and which Hume had made clear as day, in language for ever intelligible to all educated minds—the question, namely, whether we can really know things or only thoughts, whether our knowledge is objective or only subjective. It cuts up by the roots for ever, when understood, the empirical pretensions which have again imposed on so many minds in our time." Again—"Kant answers the problem, How is Science possible? or, as he elsewhere puts it, How are objects or judgments of experience or synthetic judgments *à priori* possible? thus: 'The only way this can be done is to recognise from the first that thought and things are not diverse or dualistic. The one does not exist apart from the other. Objects are not passively apprehended by the mind as something distinct from it, *but are actively constructed by it.*'" *

As I have already stated, the Absolute Idealism of Fichte and Hegel is by no means adopted by the authors of this treatise. They consider, with David Hume himself, that the real existence of Matter can be denied only by a metaphysical quibble, which carries no conviction to any sane mind. Matter, so far from being a nonentity, is the *fons et origo* of all entities. In this connection, two of the annotations appended by Dr. Lewins, may profitably be studied. "It must be steadily kept in mind—a fact too apt in discussion to be lost sight of—that Hylo-Idealism, which deals alone with the relative, ignoring the absolute as utterly beyond human *gnosis*, in no sense denies the objective, but only contends for *identity* of object and subject, proved as it is by natural Realism itself, from the doctrine of *molecular metamorphosis*, which shows the Ego continually undergoing transubstantiation with the Non-Ego, and *vice versâ*, so as to form *one* indivisible organism."† Again—"I have always striven to render intelligible the significance of Hylo-Idealism by the following illustration:—Our bodies and the so-called external universe,—*i.e.*, the Ego and Non-Ego, or, in other words, Subject and Object,—resemble a porous vessel of ice, filled with water, immersed in an infinite ocean. What is within and without, and the septum that seems to divide the two, are all three consubstantial or identical, and, owing to the porosity, always interchanging particles. So that, in reality, the seeming three are, like the mystic Athanasian Trinity, virtually one, and essentially indivisible. It is thus a distinction without real difference to speak of division between substances homogeneous and virtually *solidaire*."* Thus it is seen that man is distinct from his environment only as a cell may be said to be distinct from the matrix, or intercellular matter, which forms its home, and supplies it with nutriment. Take, for example, a cartilage cell. It lies in the midst of a territory of its own, homogeneous with itself in origin, essential structure, and chemical composition. Through this domain run a series of branching canals, by which nutritive fluids may pass to the centre. These fluids, again, are composed of the same elements as the physiological unit whose vitality they help to support, and are derived from the blood, which bathes and permeates every tissue just as the "external" environment bathes and permeates the body as a whole. Between man and the cell a very instructive parallel may be drawn. In one sense a unit, in another a complex, organism; in one sense separate from surrounding matter, in another most intimately fused and blended with it; in one sense a permanent individual, in another losing identity, by change of form and material, from day to day, from hour to hour, from moment to moment,—all this must be said of man, and all this of the animal or vegetable cell. Life, in every case, is correlated with those natural forces from which it springs, and to which it returns; or, more correctly speaking, life is due to the co-operation of all the Protean forms of material energy, which, as in azoic Nature, work automatically, and require no "spirit" to accelerate or control their activity. The phenomena of voluntary motion and individual character no more testify to the presence of an immaterial Archaeus than does the spontaneous and distinctive action of a chemical reagent. Add solution of caustic soda or potash to mercuric chloride, and a bright yellow precipitate is thrown down, while a bright blue mass results from a like experiment with soda and cupric sulphate. Here, as in human thought and deed, the activity proceeds, not from external compulsion, but from internal constitution. Objective conditions, as temperature, atmospheric pressure, &c., may be the same in both experiments, but, to speak in terms of human personality, the subjective character of the compounds tested is dissimilar, and their behaviour corresponds with this inherent heterogeneity. No doubt the laws which determine the conduct of a sentient being are far more complicated than those which govern chemical union and decomposition. But this is just what might have been expected from *a priori* considerations. The animal organism receives, assimilates, and finally breaks up and parts with a thousand complex and unstable chemical compounds; but these are only its raw materials, which are mingled in varying proportions in every microscopic fragment of the body. Minute cells are built up whose very nuclei contain an intricate network of almost inconceivably delicate fibrils. These cells are again combined into tissues adapted to the performance of their several functions, and these tissues are in their turn moulded and interwoven to form the different organs of this wonderful Microcosm. Finally, all the organs are subordinated to the rule of two sovereigns, acting with complete concert—the cerebro-spinal and the sympathetic nervous system. When we learn that a single nerve trunk is composed of hundreds of fibres, varying from 1-14,000th to 1-2000th of an inch in diameter, that each of these fibres probably transmits its own special message from periphery to centre, or from centre to periphery, and that every message exerts some influence upon the thoughts and doings of man, we need not marvel that his ways are often incalculable, and his cogitations past finding out. To regard the intellect as an entity, separable from the myriad factors which unite to produce and to direct it, is not less absurd than to consider as actual beings those personified abstractions which we meet with in poetic diction,—to believe, *e.g.*, that Gray beheld in a literal "vale of years" the "painful family of Death, more hideous than their queen," or that Milton's Satan ever conversed with Sin and Death at the gate of Hell. The following note by Dr. Lewins well elucidates my meaning:—"In medicine symptoms are the synonyms for phenomena. They can always be traced to their source in an organ, and are intensified, diminished, modified, or removed by acting on the organ. In no case can they be isolated and dealt with *per se*."* Now, the aggregate of cerebral functions or phenomena, which we call Mind, no more constitutes a separate entity than does the aggregate of abnormal symptoms, which we call Insanity.

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* One remark that, "with all his originality, Kant *never* disengaged himself from much of the traditional nonsense of philosophy," is susceptible of a far wider and deeper application than that intended by the Edinburgh reviewer. Kant started back in terror from the obvious consequences of his own principles, and endeavoured to rebuild in the "Critique of Practical Reason" what the "Critique of Pure Reason" had pulled down. The persistently dualistic character of his thought is well illustrated by his famous confession of the awe inspired by *two* things,—the order of the starry heavens and the moral law in the human mind. A consistent Monist must have felt that these "two" are essentially one.

† Page 48.

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* Page 26.

Facts and inductions like these are evidently fitted to revolutionise, not only our manner of regarding the physical Universe, but also our habits of thought and action with respect to all the higher problems of mind and of practical life. New and great ideas, if duly assimilated, must modify our views of all which was previously known or imagined, and many a cherished illusion must fall when the "Autocentric" or "Hylo-Ideal" theory is finally establised. The world of sense is a picture, a poem, a melody. Granted; but what, then, shall we say of the world of intellect and emotion? Is this the more real of the two, or is it merely a vision of the painting, a reminiscence of the lyric, an echo of the music? The answer is not far to seek. We believe that Matter is the ultimate reality beyond which it is impossible to penetrate, and that its most elementary, most general, and most easily verified manifestations are found in simple physical and psychical phenomena. From combinations of these phenomena, all our conceptions must be exclusively drawn, and by similar combinations they must be corroborated or disproved. All ideas, notions, or fantasies, are of course equally subjective, since none can boast an origin higher than the human brain; but some may be in harmony, and others in open discord, with the observed course of nature, while a third group may stand apart from facts altogether, assuming a position neither of amity nor of enmity. The two latter classes are alike illegitimate, the one being false, and the other simply irrelevant. A proposition which can neither be denied nor affirmed is for all practical purposes rejected, for, in reason, as in law: "*De non apparentibus et non existentibus eadem est ratio.*" No one can prove by induction or deduction that witches never ride on broomsticks through the air, or cast malignant spells over children and cattle; that fairies have never danced by moonlight on the green, or that the Lorelei never sat singing on her dark rock, and luring unwary travellers to destruction; yet all these fictions have imperceptibly passed away from popular belief, to a limbo prepared for dogmas and legends not less unscientific, but hitherto more tenacious of life and power. It is time that the pseudo-science of Ontology should be superseded by Physiology and Psychology, and that the vain search for final causes, to which all religion may be referred, should be renounced by those whom reason must teach to behold in the orderly arrangements of the Cosmos only a supreme glorification of Matter, the Universal Mother, and of Man, her child. In the grey cells of the cerebral cortex are generated, not only the visible Heaven, "this majestical roof, fretted with golden fire," but the poetic sense of its beauty and harmony, and even the conditions of time and space which correspond to the revolution of its spheres. For, without the intellect, time and space, infinitude and eternity, which are at present abstract concepts formed by the brain, would, so far as we know, be annihilated. Matter would still, as in geologic and pregeologic ages, continue its immortal existence; but matter, untouched, unseen, unperceived by sensation or thought, must be a void and formless chaos, until the first living eye gives it shape and colour, the first living organ of touch endows it with tangible solidity, the first living ear wakes the dumb to speech and song.

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* What is Religion? p. 40.

II. THE CONSTITUTION OF THE SUN.

By R. Lamont.

IN a former paper ("Journal of Science" for October) I tried to prove shortly that sunlight had an electric origin; in fact that the sun might be likened to the core of a huge dynamo-machine, and the outer matter belonging to our system to so many field-magnets, and that, owing to the revolution of the latter round the former, the attraction which existed between them was continually being broken, and that the breaking of such attraction resulted in a continual flow of luminous electric currents between the sun and planetary matter. I propose now to investigate the constitution of the sun with the view of further proving the probable truth of these speculations.

When viewed through a powerful telescope the sun does not present the same uniform brilliancy over his whole surface which we see when we look at him with the unaided eye. He is seen to be made up of luminous masses irregularly interspersed throughout a less luminous background, while on both sides of his equatorial belt are seen irregular black spots which emit little or no light. These spots, which consist of a dark central portion, or *umbra*, gradually blend into the brighter portions of the sun, where they are generally surrounded by very brilliant streaks of light or *faculæ*.

During a total eclipse the sun's atmosphere is seen to contain strange cloud-like masses or *red-flame prominences*, some of which appear detached from him, while others appear as if they formed part of his surface. Surrounding the entire surface, and reaching far out into space, the *corona* is seen as a bright halo of silver-white light.

With the exception of some minor details, the foregoing are nearly all the facts that have been gleaned with the aid of the telescope alone; but when combined with the spectroscope there is still a vast field to explore.

As it is beyond the scope of this paper to go into the details of spectrum analysis, I will take it for granted that the reader is already familiar with the subject, and merely state a few general principles bearing on solar phenomena.

Sunlight, as seen through a spectroscope, presents the appearance of a rainbow-tinted band, interspersed with numerous *black lines* which have been termed, from the name of their discoverer, Frauenhofer lines. These lines invariably occupy the same place in the solar spectrum, maintaining their respective distances one from another, whether the light be received direct from the sun or reflected from the moon, planets, or other opaque bodies.

An incandescent solid or liquid, when looked at through a spectroscope, gives a continuous spectrum free from black lines; but if the solid or liquid body be heated until it is in the state of a glowing vapour, the continuous spectrum will disappear, and be replaced by a series of *bright lines*, each vapour having its characteristic lines as to colour and position, so that we can at once infer to which particular element the spectrum belongs.

An incandescent body shining through a vapour gives a continuous spectrum, interspersed with black lines corresponding to the bright lines which the vapour would have given alone.

The spectrum of light reflected from an opaque body depends on the nature of the medium surrounding the reflector. If the light has to pass through a vapour before reaching the opaque body, the black lines corresponding to the vapour will be intensified, and if the reflector is self-luminous the spectrum belonging to it will be superadded to that of the reflected light.

The spectrum of any element may vary according to the conditions of temperature and pressure under which it gives out its light.

With these facts for our guidance we may now proceed to the actual examination, the first question which presents itself being—Is the body of the sun composed of the same elements as our earth, and, if so, are these bodies for the most part in a solid, liquid, or gaseous condition?

When the spectra of a number of different terrestrial elements are compared with the solar spectrum, it is found that the bright lines belonging to several of these elements exactly correspond with the position of certain black lines in the solar spectrum. From these coincidences Kirchhoff concluded that those elements which gave spectra consisting of bright lines corresponding with solar black lines must not only form part of the body of the sun, but enter into the composition of his atmosphere. He reasoned—" There is a solid or a liquid something in the sun, giving a continuous spectrum, and around this there are vapours of sodium, of iron, of calcium, of chromium, of barium, of magnesium, of nickel, of copper, of strontium, of cobalt, and of aluminium ; all these are existing in an atmosphere, and are stopping out the sun's light. If the sun were not there, and if these things were observed in an incandescent state, we should get bright lines from them."

" Such, then, is Kirchhoff's theory of the sun. There is a something—Kirchhoff said it was a liquid—which gives us a continuous spectrum, and between our eye and that incandescent liquid surface there is an enormous atmosphere, built up of vapours of sodium, iron, and so on ; and the reason that we get the dark lines is that the molecules of the substances named absorb certain rays, those, namely, which they produce when they are in an incandescent state." *

Now if this inference of Kirchhoff's, that the sun contains the same elements as the earth, be correct, it follows that if they are the same in one respect—namely, in that of emitting the same kind of light—it is almost certain that they are the same in every other respect, and that the elements which go to form the sun obey the same chemical and physical laws as these elements would do at the earth's surface.

If we accept this elementary sameness as a fact, and wish to explain solar phenomenon on a fiery basis, then since iron, calcium, and magnesium are invariably found in the spectrum of the sun's atmosphere, and since these bodies cannot be rendered gaseous without first passing through the liquid condition, we must infer that, if not the whole, at least the surface of the sun is in a molten state. And this molten mass must consist either of layers of the elements arranged according to their densities, or of a homogeneous mixture formed in accordance with the laws of liquid diffusion. And the gaseous envelope surrounding the sun must also be diffused or stratified in the same manner.

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* LOCKYER'S Solar Physics.

Now what kind of spectrum would such a constitution give? It would very probably give the solar spectrum line for line and band for band, but it would give the same spectrum over all its parts. This as a matter of fact is not the case, as we find the umbra of a spot to vary from its penumbra, faculæ to be distinguishable from the adjoining surface, and the sun's atmosphere itself to give an ever-varying spectrum. If to fit this changing spectra we assume the sun to consist of a *solid body* surrounded by *glowing vapours*, we will, at the same time, require to endow solar elements with properties differing widely from our own. In fact we at once require to resign the only certain ground that we have to work upon, and return to the doubts and difficulties of a bygone age.

Everywhere throughout Nature we find simplicity and uniformity,—a solid changing to a liquid, and a liquid to a gas. But nowhere do we find gaseous iron, calcium, or magnesium suspended over solid sodium, nickel, or zinc. As long as our predecessors tried to explain planetary motion by their intricate cycles and epicycles, so long did they fail; but the moment they applied the laws governing the motion of terrestrial matter all became simple, and their hitherto erratic hosts were seen to obey the same laws as the matter strewn around them. We know that the attraction which binds sun, planet, and system together is everywhere the same, whether it be engaged in building up the atoms of a chemical compound or holding together the constituents of a universe. Are we to accept this as an infallible law, not only when applied to force, but when compared with matter, the progenitor of force, and to hold that wherever matter is found there will we find it endowed with the same properties as terrestrial matter? If we do this, and accept of the coincidence of the Frauenhofer lines as a sure index that the sun is made up of elements exactly the same as our own, then we require to find a new explanation for the phenomena taking place at the surface of the sun.

As already mentioned, the sun, when seen through a powerful telescope, is no longer the bright unblemished mirror which our forefathers had pictured in their minds, but is seen to be a coarse-grained unpretentious-looking body, with its full complement of corrugations, pores, and granules, and its bright faculæ as it were to light the way to the deep profundities of its vast willow-leaf strewn caverns.

What do we know about these cavities? Are they really vast cavernous depths reaching far below the surface-clouds hanging in a transparent atmosphere,—scoriæ floating on a molten mass,—rifts in the sun's mantle, through which his *dark surface* is seen? or, lastly, is the sun a world like our own, consisting not only of the same elements, but of land, river, and sea; and are the dark spots which we see but the sun's huge *oceans* partly laid bare by the rolling back of his cloudy covering? And are our red-flame prominences but watery vapour, at one time wafted along by the gentle breeze, at another riven and torn by the furious hurricane? And are our pores, granules, and luminous masses but the appearances which result when a series of electric discharges take place from a mixed conductor, obscured by a semi-transparent envelope?

In the electric spark we have heat, light, and chemical rays nearly—if not exactly—the same as those we receive from the sun. While the spark is capable of volatilising our most refractory substances, it does not appreciably *heat* the body from which the spark is drawn. But if it *meets with resistance* in its passage from one body to another, then heat is generated in proportion to the resistance encountered.

Now suppose the sun were constituted exactly like our own earth, with its green fields, mountains, seas, atmosphere, and clouds, and all the phenomena pertaining thereto; and, further, that electric sparks were issuing from every part of its surface capable of producing a spark. How would this supposition compare with what we know about the sun?

From our knowledge of electricity it is almost certain that, owing to varying conduction, the solid parts would emit light, varying in quality and intensity according to the composition of the matter from which the light emanated, and that *the liquid parts would emit little or no light.* If such a conductor were viewed without the intervention of any obscuring agent, this unequal luminosity would be distinctly seen even at great distances. But if obscured by an atmosphere more or less saturated with aqueous vapour, then, owing to refraction and reflection, the light would be seen to be nearly equally dispersed over the whole surface, and no inequality would be observed unless when condensation of the vapour took place at one part more than another.

That such local condensation does take place we have positive proof, from the fact that the sun's atmosphere is seen to contain cloud-like masses, which, when examined by the spectroscope, give a strong indication of their being principally made up of hydrogen gas, an element which invariably results from the decomposition of aqueous vapour by the electric current.

If we were merely searching for an analogy between solar and terrestrial phenomena, we might point to the sun's undoubted solidity and revolution on his axis,—his similarity of composition,—his atmosphere and clouds,—his aërial currents and cyclones,—the correspondence of his spot belts with our sub-tropical zones,—and last, though by no means least, *the correspondence of these belts with the situation of our own oceans.*

But analogy alone is no proof. We require more than mere resemblance. His atmosphere and clouds, though like in appearance, might differ greatly in composition from our own; his aërial currents might bear the breath of the fiery furnace; and his oceans, though occupying the same relative positions, and stirred by the same forces, might be very different from the simple compound of oxygen and hydrogen with which we are acquainted. Still, we cannot get away from the fact that where there is a somewhat complete analogy there is probably a more intimate connection. But, be that as it may, it is from the correspondence of the spot-zones with the position of the greater bulk of the waters of our oceans that we mean to draw our chief argument.

Sir Wm. Herschel supposed the sun to be a non-luminous body surrounded by a luminous atmosphere, and sun-spots to be rifts in that envelope through which his dark body was seen. We, on the other hand, suppose the solid or earthy parts to be luminous, and the liquid parts to be nearly non-luminous, so that if a rift took place in his clouds over a solid part we would see that part more luminous than its surroundings; but if the opening took place immediately over water, then it would be seen as a comparatively dark spot, bright at the edges from reflection, and more or less shaded towards the centre, according to the height above the surface of the water at which the rift took place.

That such appearances would result from an arrangement of this kind can be easily demonstrated as follows:—Stretch a piece of white paper over the mouth of a glass funnel blackened inside to exclude outside light, and make an opening of about half an inch in diameter in the centre of the paper. Then fix the funnel mouth downwards at a short distance over water contained in a vessel with blackened bottom, and a little less in diameter than the funnel. Here, the paper represents the sun's envelope; the aperture, a sun-spot; the water, the liquid part of his surface; light from the outside, rays emanating from his solid parts; and an eye placed at the opening in the neck of the funnel, an observer at the earth's surface. On looking through the neck of the funnel towards the opening, the general surface of the paper appears more or less illuminated according to its transparency, while the borders of the aperture are more brightly illuminated and are surrounded on the inner side by what at first sight appears to be a halo terminating in a dark central portion, but which, on further examination, is found to be a reduced image of the opening reflected from the water to the eye. In fact, with a small tuft of cotton-wool over the aperture, and a pan with irregular bottom underneath, it is possible to produce all the appearance peculiar to sun-spots.

From these appearances alone we might be able to find an explanation for spot phenomena, but fortunately in this case we do not require to depend altogether on appearances, as from the indefatigable labours of our spectroscopists we learn that spot spectra are not the same as spectra from any other parts of the sun's surface, but show signs of increased absorption, the point of greatest absorption being at the centre, and decreasing therefrom towards the edges.

Now, if our supposition that spots are openings in the sun's clouds over water be correct, it follows that all rays of light travelling from the shores of the oceans, or from the waters of the oceans, over which we suppose visible spots are formed, will require to cross each other before they can pass through these openings, and that the points of maximum crossing will be at or near the centres, and that the points of minimum crossing will be at the edges of the openings. Let us compare this *optical fact* with what we know about spot spectra. The point, in our hypothetical spot, where the greatest number of rays cross is at the centre, exactly corresponding to the part where we find the greatest absorption in sun-spots. The point of least crossing is at the edges, where we find little or no increased absorption in sun-spots. Again, the lines that show by far the greatest absorption in sun-spots are those belonging to sodium and hydrogen. What does this fact point to? Is it to the emanation of an excess of the *feeble* monochromatic light of sodium and hydrogen from the oceans beneath? and are we to infer therefrom that directly beneath the spots there is not only water, but sea-water, the same as which is laving our own shores?

This latter question contains much more than it would at first appear to indicate. It is not a question merely as to the presence of an excess of sodium or hydrogen light, but also, first, as to whether or not the presence of metallic vapours in the sun's atmosphere is necessary in order to explain the appearance of their absorption lines in the solar spectrum; and secondly, as to whether or not the preponderance of one kind of light produces increased absorption of that light.

From spectroscopic observation we learn that while the spectra of the sun's chromosphere and prominences are made up of a few permanent *bright lines*, there are others which seem to appear and disappear, as if their presence depended on the locality under examination. Are we to draw from this the inference that the sun's gaseous envelope has not a uniform composition, but that while a few of its elements—among which we must class hydrogen—obey the laws of gaseous diffusion, there are others which do not, owing to their being possessed of some unaccountable property that allows them to be present with, while yet not diffused through, their more obedient companions? Or might we not reason from these facts that the constant bright lines indicate an atmosphere as uniform and simple as our own, and that the presence of the hydrogen lines points to that atmosphere as being impregnated with aqueous vapour? And, further, that the fleeting bright lines do not belong to gaseous matter in the sun's atmosphere, but to his discontinuous light reflected to us from his clouds? Lockyer ("Solar Physics"), in describing a prominence, says—"Judge of my surprise and delight when, upon sweeping along the spectrum, I found hundreds of the Frauenhofer lines beautifully bright at the base of the prominence." This is exactly where they should appear if they are to be explained by reflection from the surface underneath.

If the fleeting bright lines do not belong to the sun's atmosphere, then the solid body of the sun does not give a continuous spectrum, as supposed by Kirchhoff, but spectra varying according to the composition of the matter from which the light is emanating. Neither is it probable that the Frauenhofer lines are due to absorption in a metallic gaseous medium, but more probably to a mere crossing of the same kind of light rays, as is indicated by the point of maximum crossing in our hypothetical spot, corresponding with the observed point of maximum absorption in sunspots.

There is still another point in connection with our spot hypothesis that requires investigation, namely, the sheaf-like rays of light seen to proceed from the sun during total eclipse. On the hypothesis of incandescent solid and glowing vapour, how are we to explain this clubbing together (if we may use the term) of light rays? Is it on the assumption of unequal luminosity of the solid body of the sun? If so, then, how are we to account for the irregular direction of the rays? If we were to assume refraction to be the cause, we would immediately be met by the fact that rays evidently emanating from almost the same parts of his surface appear to be oppositely affected, the one group streaming out to the right, while the other goes to the left. Besides, even supposing such was not the case, we cannot but imagine that a medium, sufficiently dense to refract light so far off its natural course, would have a tendency to reduce its intensity to that of the light emanating from the less luminous parts of the surface. On the hypothesis of the sun's being a luminous body enveloped in clouds, if the cloudy covering were all of the same density, and the solid of equal luminosity, there would be uniform radiant light; but if the solid were not uniformly luminous, and there were breaks in the cloudy covering, then the unequal radiant light would be seen to be overlapped or crossed by bright sheafs or streaks of light, proceeding from the openings, the direction of such streaks depending on the positions of the openings as regards the points of emanation of the light. But whatever direction these rays of light originally took, if our theory be correct, they would eventually have to return to a direction in a line with the plane of the ecliptic, which probably accounts for their generally curved appearance.

Next, with regard to solar heat, are we still to hold to our fiery theories, and see the sun as a gaseous or molten mass, the heat of which is maintained by condensation, friction, chemical action, or the impact of other bodies; or are we to account for his heat from one of our most stable laws, namely, that *when force is retarded by matter, heat results?* If we do so, then the force which we receive from the sun, call it what we will, must be retarded in its passage through the sun's atmosphere; therefore heat must result. Part of this heat will be reflected back to his surface, and part *probably* escape into interstellar space. Of this latter part (if any) we will receive our share. But would this be sufficient to account for all the heat that we receive at the earth's surface? I think not; but I do think that it is here that the economy of Nature steps in. His heat is of no use in interstellar space,—it is the worlds circling round him to which it is necessary; consequently these worlds are provided with a gaseous envelope like his own, which retards his force in its passage through them, thus producing the heat so necessary for the support of animal and vegetable life exactly at the point where it is required.

III. COMING SHADOWS: AN ETHNOLOGICAL STUDY.

By E. S.

THERE is little pleasure in foretelling evil, and especially in pointing out the illusory character of any hopes that may have been entertained by friends, neighbours, and countrymen. Sometimes, however, so to act becomes a painful duty. In speculating upon the future condition of humanity authors and orators have given a brilliant forecast of the progress of the "Anglo-Saxon" race. The correctness of the term here used I will not discuss, since no one can pretend to misconstrue its meaning. The outlook has latterly become more dazzling than ever since the two great branches into which that race is divided have laid aside much of the mutual jealousies which they entertained during the earlier half of the present century. Accordingly we have been told that by the year 2000 A.D. this race would in fact dominate the globe. One great English-speaking community would occupy Australia and the islands of the Pacific; another, seated in South Africa, would gradually overspread the table-lands and mountain-ranges of the "dark continent." Whether these two communities remained members of a British Empire, or became independent Republics, the result would, for the world at large, remain substantially the same.

In the Western Hemisphere the case was even less doubtful. The Great Republic, it was said, would gradually overspread the whole of the continent, and the English tongue would alone be spoken from the confines of the Polar Ocean to Tierra del Fuego. Here, also, it was argued that mere political changes could little affect the main issue. The Republic might break up into two or more distinct bodies, or might even adopt monarchical institutions, but it would all the same remain a vast "Anglo-Saxon" community. It was calculated—and doubtless correctly—that by the end of the next century the population of the United States would exceed 500 millions. It was shown what must be the influence and the power of such a nation, wealthy, intelligent, energetic, and inventive. Nor have writers forgotten to lay due weight upon the assimilative power of this race. The Frenchman, the German, the Spaniard, even the Irishman, are all incorporated, and, losing their distinctive peculiarities, are fused up into the American.

The future thus limned was one to which neither American nor Englishman could look forward without a thrill of pride. But one element in the calculation has been overlooked. There can be very little doubt but that the population of the United States will, by the year 2000 A.D., have reached, and even overstepped, the full tale of 500 millions. But of what will it consist? Of those whom we call Americans, substantially our kinsmen, though more or less crossed with German, French, or Spanish blood? We fear not. There is, indeed, no occasion to take into account the aborigines, or Red-skins, misnamed Indians. Their doom is evidently in part extinction and in part absorption,—the latter to a greater extent than is commonly supposed.

Nor is the Chinese immigration, even if not forcibly suppressed, to be here taken into account. The Chinese, however undesirable their appearance in America may be on other grounds, are not there in the character of true settlers. They come and obtain work; they amass money with the hope of returning later in life to the Central Flowery Land. They do not bring up families upon American soil, or in any way seek to cast in their lot with their white neighbours. They follow the example of certain aliens in England, who, if temporarily among us and yielding a passive submission to our laws, are not of us.

The factor hitherto disregarded in estimating the future of America is the negro race. It is well known that the first settlers in America, to whatsoever European nation belonging, committed the serious mistake of importing negroes from Africa as slaves. It is not yet known to what an extent they have, by so doing, compromised the future of their remote descendants. Nor must it be for a moment supposed that the emancipation of the negro from slavery and his admission to the rights of citizenship have at all removed the difficulty. Here was the mistake of the Abolitionists. So long, of course, as slavery was recognised in the United States, neither its defenders nor its denouncers, as a body, saw what the future might have in store. A few clear-headed men, indeed, advocated the removal of the negro element in mass—their re-shipment to West Africa; but they were denounced by the one party as covert Abolitionists, and the other accused them of inhumanity. Above all, the rate of increase of the negro population was totally unsuspected. Men comforted themselves with the imaginary ethnological law that a lower race, placed in contact with a higher, tends, in some mysterious manner, to decline, and ultimately passes away. This supposed law is founded upon a very imperfect generalisation. It held good in the case of the North American "Indians." It holds good with the aborigines of Australia, and even with the Maoris. It does not hold good with the African blacks, who—like mice, rats, house-flies, &c.—seem to multiply more rapidly when brought in contact with civilisation than when left to themselves.

At the time of the forcible emancipation of the negro slaves in the American Union they numbered, it is supposed, about four millions. For the decade 1860 to 1870 the census gives no very trustworthy results. The disturbance arising from the long civil war, and the very imperfect manner in which the population of the Slave States had previously been enumerated, combined to render estimates of negro increase during that term of years open to question. But the census of 1880 showed an alarming result,—alarming not merely to Americans, but to us in England. It proved that the emancipated negro population was increasing at the rate of 3½ per cent per annum, and was consequently doubling itself every twenty years. The white population for the whole of the United States, on the contrary, was found to be increasing at the rate of 2 per cent per annum only, doubling itself, therefore, every thirty-five years. Hence it may easily be calculated that, if these respective rates of increase continue, the blacks must outnumber the whites. Prof. E. W. Gilliam ("Popular Science Monthly"), from whom I borrow the numerical results already given, states that in the United States, taken as a whole, the whites will in 1985 number 336 millions, whilst the blacks in 1980 will amount to 192 millions, and will about double the number of the whites in the Southern States. Consequently in 2000 the blacks will reach 384 millions, and in 2020 actually 768 millions. In the same year the number of whites will be only 672 millions. Hence by that year the blacks will have a clear majority of 100 millions, and will be virtually the sovereigns of the United States. The Anglo-Saxon Republic will have become substantially a Negro Republic, and every decade will more and more confirm that character. The black, by the sheer force of his fecundity, will outweigh the superior intellect and energy of the white!

How can such a calamity to America, and to the whole world, be averted? A fusion of the two races Prof. Gilliam—rightly in my opinion—pronounces impossible. He writes:—"Account for it as we may, the antipathy is a palpable fact which no one fails to recognise,—an antipathy not less strong among Northern than among the Southern whites. However the former may, on the score of matters political, profess themselves special friends to the blacks, the question of social intermarriage and social equality, when brought to practical test, they will not touch with the end of the little finger. Whether it be that the blacks, because of their former condition of servitude, are regarded as a permanently degraded class,—whether it be that the whites, from their historic eminence, are possessed with a consciousness of superiority which spurns alliance,—the fact that fusion is impossible no one in his senses can deny." I fully admit this conclusion, but I should seek the cause in a simple racial repugnance, founded not on what has been, but on what is and must be. An eminent German professor whose views have been expounded in the "Journal of Science" would doubtless here point to the specific odour of the black, which to the senses of the white is intensely offensive. Under ordinary circumstances no Aryan man would seek a negress as a wife, whilst the notion of an Aryan woman becoming the wife of a negro seems simply revolting. It is noteworthy that since the emancipation the production of half-breeds—one of the worst results of slavery—has decreased, if it has not come to an end altogether. The probability of a fusion of the two races may be in fine dismissed, and it will appear at the same time that the blacks must remain as that dangerous phenomenon an *imperium in imperio.*

It may be asked, Is there any hope that the more rapid increase of the Negro as compared with the Aryan depends upon temporary conditions, which it might be hoped may not be permanent?

Prof. Gilliam maintains that the key to the different rate of increase is found in the superior fecundity of the blacks as a race, "and is strengthened for them—1. As being the labouring class; 2. As labouring under favourable climatic conditions; *i.e.*, living in a semi-tropical region." The second of these conditions evidently applies to the Southern States only. In the Middle and Northern States the negro must encounter fluctuations of climate and a winter cold very different from those which prevail in the cradle of his race.

But there is one point in favour of the blacks—or rather in disfavour of the whites—which Prof. Gilliam has overlooked: judging from the medical papers, means for the limitation of a family are adopted in the Northern States, as in France. It has been shown, and is indeed self-evident, that Malthusianism, if practised by any one class or nation, means self-effacement. To be efficacious it would have to be universal. That it will not be adopted by the Negro race is certain.

As to the alleged greater fecundity of the blacks, not in virtue of their race, but as a labouring class, some doubt may exist. In France the so-called working population—or, to use the happier expression of Prof. Owen, the "wage class"—is not remarkable for rapid increase. It is said, jokingly of course, but not without a basis of truth, that the *ouvrier* never becomes a grandfather. In England the clergy, who are certainly not taken from the lower orders, have often been denounced by Malthusian writers for their large families. Royalty itself has incurred the same censure. Perhaps, before finally pronouncing that the increase of the Negro is, by a natural law, more rapid than that of the Aryan, it may be well to await the result of at least another census, that of 1890. Whether practicable precautions should not at once be taken is a question not for the ethnologist, but for the politician, and is consequently unfit for discussion in these pages.

Meantime it must be admitted that there is danger not merely in the ultimate numerical predominance of the blacks, but in their very presence as a free alien body placed by artificial devices on a political level with a superior race. In the Southern States of America, after the collapse of the Confederacy, their conduct was marked by such outrages that "bull-dozing" was but a natural reprisal. In the British West Indies they have shown their gratitude for emancipation by insolence and rebellion.

As regards Nicaragua Mr. Belt writes:—"In Central America there never were many black slaves; since the States threw off the yoke of Spain there have been none; and this comparative scarcity of the Negro element makes these countries much more pleasant and safer to dwell in than the West Indies, where it is much larger. The Indian seldom or never molests the whites, except in retaliation for some great injury; whilst among the free Negroes robbery, violence, and murder need no other incentives than their own evil passions and lust." * What will be the condition of the United States when, if ever, this race has the power to elect judges, governors, and legislative bodies, needs no description. That the Aryan race will submit is impossible, and the consequence must be, I fear, a civil war far more bloody than the last, because a war not of parties, but of races.

Prof. Gilliam predicts grievous results from the co-existence of two incompatible races, but, as it seems to me, on questionable grounds. He writes:—"If the blood of the black population cannot commingle with that of the whites [and he has himself shown that this is impossible] social advancement ceases at an early stage; the higher social planes are incapable of attainment, whereby is broken a fundamental social law that allows the individual full freedom to rise or fall in the social scale without hindrance from race prejudice or prestige." Here the author misstates the issue: the obstacle to the rise of the Negro is not "race prejudice or prestige," but racial inferiority. The "fundamental social law" of which he speaks can hold good only within the boundaries of a race. I admit that an average Aryan, be he American, Englishman, Irishman, Frenchman, or German, is the equal of any other average Aryan, and may claim equal scope. I admit that the individual Negro is the equal of another individual average Negro, but I cannot admit that the average Negro is the equal of the average Aryan. If politicians, economists, ethicists, or the like, place him on an artificial equality, they are the law-breakers, and must be held answerable for the consequences. What the blacks can do when set free, and allowed to take the reins into their own hands, may be seen in Haiti, where now for nearly a century they have played at empires and republics—a laughable farce did it not involve the ruin and waste of a lovely and fertile island.

Prof. Gilliam continues, still overlooking the innate heterogeneity and disparity of the two races:—"That is the healthiest society which is the freest, which gives the fullest play to individual intelligence and energy; and in such a social state we note a tendency on the part of the rich upper class to sink, and the poor labouring class to rise." The relation of the white to the black is not, as I must here again remark, that of the rich to the poor. It is to be here also noted that the Professor seems to conceive of an upper

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* Naturalist in Nicaragua, p. 64.

and a lower class only as rich and poor, forgetting that intelligence and refinement are not necessarily functions of wealth. He proceeds :—"The causes [of this slow change of places] are apparent. The sons of the rich eat daintily, exercise daintily, keep late hours for resting and rising, are self-indulgent and extravagant. There are, of course, exceptions. Undoubtedly, however, the surroundings of the sons of wealth create tendencies this way toward effeminacy of body and uneconomical habits of mind. The poor, on the other hand, are compelled, by their conditions of life, to strength-giving exercise and careful saving methods in the management of means. Robust bodies and thrifty ways give upward tendencies, which, acting through the social cycle, lift the descendants of the poor to the higher planes."

Even within one and the same race this picture, I maintain, is overdrawn. The "sons of the rich," in England at least, are given to athletic open-air pursuits, at school, at college, and in after-life. The English squire and the German junker show small marks of effeminacy, and are generally superior in stature to the labourers on their estates. On the other hand, the employments of the poor, save in agriculture, can rarely be called "strength-giving exercise." It would be easy to enumerate a score of trades, including most departments of textile manufactures, pottery, tailoring, shoemaking, steel-grinding, working with lead in any of its forms, and almost all the retail branches of distributive industry, which are positively debilitating and life-shortening. In many cases work is begun at too early an age, before the muscles and the joints are sufficiently matured,—consequently the whole frame is more or less crippled. Unwholesome food, ill-drained and over-crowded houses also prevent the development of robust bodies among the poor. As for thrift it is quite as rare among the poor as among the upper ten thousand. One of the most difficult lessons which philanthropists have to instil into the wage-class is the economical management of means.

I should hence argue that the danger to be apprehended in America is not due to any breach of a social law, but to a couple of blunders, the first and gravest being the introduction of the blacks into the Western Hemisphere at all, and the second their investiture in the United States with the privileges of citizenship.

In South Africa the British Empire meets with the same difficulty, though on a smaller scale. The various black tribes, instead of fading away at the approach of the white man, multiply more rapidly under the British flag, so that the opening for an "Anglo-Saxon" community there becomes less and less. Australia may be devoutly thankful that her soil is free from the African negro,—a worse scourge than the rabbit, and for the very same reason.

II. THE BIRTH AND EVOLUTION OF THE SOLAR SYSTEM.

TRANSLATED FROM PAGES 113 TO 132 OF "GEDANKEN"
(1857, Philadelphia, published by Thomas).

By O. REICHENBACH.

(Continued from page 70.)

IN the analysis of bodily proportions which result from the first becoming and motion I have pointed out how excentricity of the equatorial plane is derived, and how it becomes a condition for unequal velocity of the sides converted to and averted from the attracting body, and for a process of condensation and dissolution. The planetary mass, unrolling with tremendous power, here projects matter to $77{\cdot}3\,r$ distance from the receding sun, and sends it to the opposite side by centrifugal force, where it is not repulsed, but re-attracted by the sun. Matter on the side averted from the sun does not extend to the distance of $680^2\,r$, but, under the recalling influence of a mass 680 times greater, only to—

$$\frac{680^2}{\sqrt{680}}\,r = 17{,}680\,r.$$

We have now limits of the planetary mass $77{\cdot}3\,r$ and $17{,}680\,r$ solar distance; we have to find the point of gravitation, the real mean distance to which the mass rebounded. At the beginning of motion the measure was R. The required distance is the mean proportional of the forces opposed in mass and motion :—

$$\frac{1}{\sqrt[3]{680}} = \frac{1}{8{\cdot}8} \text{ and } \sqrt{680} = 26 \qquad \frac{1}{8{\cdot}8} :: 26 = 1{\cdot}72\,\mathrm{R}$$

$$1{\cdot}72\,\mathrm{R} = 1169{\cdot}6\,r \text{ distance,}$$

or by limits—

$$77{\cdot}3\,r :: 17{,}680\,r = 1169{\cdot}6\,r.$$

It lies somewhat beyond the mean distance of Jupiter. As the central part we must consider this quantity repulsed to $1169\,r$ distance, but a simple distance gives a point only. According to the rotary motion, which the central part received at first, it moved for its new site $\sqrt{1{\cdot}72}$ too rapidly; it went as central yet dissolved mass $1{\cdot}72$ farther, or this was the excentricity of the central evolution cycloid. The mass had, using a familiar expression, a perihelion and aphelion of rotation, between which the inner strata circulated. It went then to $1{\cdot}72^2$ of distance; consequently to—

$$1169\,r \times 1{\cdot}72 = 680 \times 2{\cdot}96 = 2006\,r.$$

We have the two points, poles, the one beyond Jupiter, the other this side Saturn.

But in this representation of unrolling through centrifugal force I did not account for the perturbations produced by the centrifugal force of the sun, yet they exist and continue through the whole development of motion, and the differences in effect on an extended body.

The opposite points of each body had to move with another rotary velocity than the mean ones, which brought them closer together; on the other hand, had the part converted to the sun to remain nearer to it, the averted part to remove farther from it, this is indicated by the proportions found.

The centrifugal force of the sun was $1\text{-}77{\cdot}8$, the planetary radius $77{\cdot}3\,r = 1\text{-}8{\cdot}8$ R. The rotary velocity produced by the sun so became, in the mean of the oppositions, diminished $1\text{-}8{\cdot}8$, and translation was increased by the same quantity. Rotary velocity became $77{\cdot}3 - 8{\cdot}8 = 68{\cdot}5$ times more rapid than that of the sun. It is therefore as if this body had $68{\cdot}5\,r$ as mean radius. The velocity of rotation became now, on the side converted to the sun,—

$$\frac{680 + 68{\cdot}5}{680} = 1{\cdot}107,$$

and on the side averted from it—

$$\frac{(680 + 68{\cdot}5) + (68{\cdot}5 + 2{\cdot}96)}{680} = 1{\cdot}22 \text{ times}$$

more than it had to be. The sun was not at the same distance from the converted and averted sides of the planetary mass. Inversely as the square of distance, the force of approaching and staying behind must decrease.

As the central mass here moved away to 1·72 R, it had to remain behind with its part nearest to the sun—

$$\left(\frac{68{\cdot}5}{\sqrt{1{\cdot}72}}\right) r = 52{\cdot}4\, r\,;$$

we have $1169\, r - 52{\cdot}4\, r = 1116{\cdot}6\, r$ as the mean position of the central perihelion, as that of Jupiter; as the mass removed on the averted side to 2·96 R, it had to escape to—

$$\frac{68{\cdot}5\, r + 2{\cdot}96\, r}{\sqrt{2{\cdot}96}} = \frac{68{\cdot}5\, r + 2{\cdot}96\, r}{1{\cdot}72} = 41{\cdot}6\, r,$$

and $2006\, r + 41{\cdot}6\, r = 2047{\cdot}6\, r$, equal to the solar distance of Saturn. We have $52{\cdot}4\, r$ and $41{\cdot}6\, r$ as mean elongations or evections of the two central masses; quantities with which the quantities 1·107 and $1{\cdot}107^2 = 1{\cdot}22$ interfere as quantities of motion; the former as characteristic of the centre become perihelion, the second as that of the central aphelion, projection of the former.

When the body moves in remoteness 1·22 slower, it moves in proximity $\sqrt[4]{1{\cdot}22}$ times more rapidly; when it moves in its proximity to the sun, 1·107 faster, it goes in its remoteness $\sqrt[4]{1{\cdot}107}$ times slower. We so have the mean into the ideal distances:—

Jupiter ... $\dfrac{1169\, r}{1116\, r} = 1{\cdot}049$ (rounding 1·05).

Saturn ... $\dfrac{2047{\cdot}6}{2006} = 1{\cdot}024\, r$ (rounding 1·025).

Their mutual distance is $1{\cdot}72 \times 1{\cdot}05 \times 1{\cdot}025 = 1{\cdot}84$.

$$1{\cdot}025 : 1{\cdot}05 = \sqrt[4]{1{\cdot}107} : \sqrt[4]{1{\cdot}22}.$$

These disturbance figures—

$$1{\cdot}025^2 = 1{\cdot}05$$
$$1{\cdot}05^2 = 1{\cdot}107$$
$$1{\cdot}107^2 = 1{\cdot}22$$

derived from the principal ones—

$$1{\cdot}72$$
$$1{\cdot}72^2 = 2{\cdot}96$$
$$2{\cdot}96^2 = 8{\cdot}8$$
$$8{\cdot}8^2 = 77{\cdot}3$$
$$8{\cdot}8^3 = 680$$

form the more complicated mechanism of the whole system.

We thus have the solar distances of the two central masses—

$$\frac{2047\,r}{1116\,r} = 1 : 1{\cdot}87.$$

Observation gives the densities of sun and planets. Slight differences of density between those observed and here deduced are irrelevant, for nothing is more uncertain than the exact mean diameter of planets, and for density the error increases to the cube.

Observation gives, if the density of the earth be taken as 1, that of the sun 0·252, of Jupiter 0·243. The density of solar and planetary mass was equal, but Jupiter remained 1·05 this side of the point of gravitation; so much less was it condensed, we have its density 1-1·05 of that of the Sun, or—

$$\frac{0{\cdot}252}{1{\cdot}05} = 0{\cdot}240$$

of that of the Earth. Observation gives the density of Saturn 0·140. It is—

$$\frac{0{\cdot}252}{0{\cdot}140} = 1{\cdot}8 = 1{\cdot}72 \times 1{\cdot}05 = \frac{1{\cdot}84}{1{\cdot}025}.$$

The density of Saturn is so much less than that of the Sun as its distance is greater than that of Jupiter when divided by that distance which it moved beyond its ideal position. This farther distance increases its density, as that of Jupiter is less by its remaining this side of the point of gravitation. The density of Saturn to that of Jupiter is therefore 1 to 1·72.

Observation gives the mass of the Jupiter system 1-1047·8 of the Sun; of the Saturn system, 1-3501·6. The former contains 3·345 more mass than the latter: 1 to 1·84 is the solar distance of Jupiter to that of Saturn; $1{\cdot}84^2 = 3{\cdot}45$, or inversely as the squares of distances are the masses of the two central concentrations, or Saturn is—

$$\frac{1}{1{\cdot}72^2 \times (105 \times 1025)^2}$$

of the mass of Jupiter.

The planetary rotation, 77·3 times more rapid than that of the sun, became diminished by the opposing centrifugality of the sun, gradually diminishing the oblateness of the mass; transportation became accelerated, and the rapidity of rotation became 68·5 times that of the sun. If we thus might find the whole planetary mass in 1·72 R distance, it would rotate 68·5 times more rapidly than the sun. But as the mass remains in the perihelion of revolution 1·05 nearer, rotation becomes—

$$\frac{68{\cdot}5}{1{\cdot}05^2} = 62{\cdot}5,$$

or so much more rapidly rotates Jupiter than the Sun. As the mass now circulates to the aphelion, and passes here $1\text{-}1{\cdot}025^2$ beyond its ideal position, rotation becomes $1\text{-}1{\cdot}025^2$ of that of the perihelion, or Saturn revolves only—

$$\frac{62{\cdot}5}{1{\cdot}025^2}$$

more rapidly than the Sun.

But the mass did not merely circulate between those two central parts in cycloidal form; it was projected to 77·3 *r* and 17,680 *r* from the Sun. Could the conical extremes now keep up in transportation round the Sun with the central masses, and return to them; or had not mass to tear off on either side and to unite round poles,—that is, reversing points? Where now the translatory velocity in more and less was as 1·72 to the mean one, there the mass had to separate,—consequently in a solar distance of—

$$\frac{1169\,r}{1{\cdot}72^2} = 397\,r,$$

and $11{,}69\,r \times 1{\cdot}72^2 = 3448\,r$, here beyond Mars, there this side of Uranus.

These tearing-off masses concentrated round projected points. We find, as their points of gravitation for the interior system—

$$77{\cdot}3\,r :: 397\,r = 176\,r \text{ solar distance;}$$

for the exterior one—

$$3448\,r :: 17{,}680 = 7808\,r.$$

The interior system, projected by Saturn, is repulsed; the exterior one, projected by Jupiter, is re-attracted by the Sun. An image of the process may be found in a comet which points with a small cone sunward, its substance flowing from the side turned away from the sun and resting on its central portion,—and points with a larger cone away from the sun, its substance issuing from the central part of the side turned towards the sun. After separation had taken place the three groups adopted ellipsoidal forms, and presented an aspect similar to that which the three-linked comet must have shown about which Chinese chronicles tell us. The mass has four poles reduced to the equatorial plane; Jupiter and Saturn, the interior and the exterior system, each of the two latter systems presents again four poles. The mass, in shape three coupled zeros, circulates in double motion, and concentrates at the points of intersection and reversion. The asteroids are fragments and vapours condensed in the districts of separation.

It must be, of the whole mass, Jupiter—

$$\frac{1{\cdot}105 \times \sqrt{1{\cdot}025}}{1{\cdot}72}$$

Saturn—

$$\frac{\sqrt{1{\cdot}1025}}{2{\cdot}96 \times 1{\cdot}72 \times 1{\cdot}05}$$

The exterior system—

$$\frac{1}{29{\cdot}6 \times 1{\cdot}72 \times 1{\cdot}21 \times 1{\cdot}05}$$

The interior system—

$$\frac{1}{77{\cdot}3 \times 1{\cdot}72 \times 1{\cdot}05}.$$

The mass, not of Saturn, but of its whole complicated system, has retained mass at the expense of the exterior and the interior system, whereby the elongation of Saturn is somewhat smaller.

If we then divide the mass logically in 680 parts, the system of Jupiter contains 442 parts, Saturn 131, the exterior system 104·2, the interior 2·83.

Or it is not exactly, but pretty near, the mass of Jupiter to that of the exterior system, as the square of the mass of Saturn divided by the square of that of Jupiter to the mass of the interior system divided by that of Saturn.

Which are the relations of distances in the two separated systems? The points of gravitation are the hinges on which they swing. I begin, not quite logically, with the interior system, because it is the better known.

It is projected from Saturn, and re-attracted by the larger

Jupiter; the direct projection is Venus; the mass is recalled by Jupiter which produces the Earth. Mercury is the projection of the Earth; the latter nearer Jupiter yields less mass; Mars is the projection or circulating stratum,—the undulation of Venus, nearer Jupiter; the former obtains a larger share of mass from its central planet.

We have distance of Venus from the point of gravitation—

$$\frac{176\,r}{156\,r}=1{\cdot}1\times1{\cdot}025=1{\cdot}22 \text{ aphelion.}$$

$$176\,r-156\,r=20\,r. \qquad 214\,r-176\,r=38\,r.$$

$$\frac{38}{20}\,r=1{\cdot}9=1{\cdot}72\times1{\cdot}1.$$

We had as limits of the system 77·3 and 397 r. The latter figure was obtained by the central point of gravitation; the elongation of the central mass must produce a district of separation, inside which the separate mass oscillates. I take at once the inner and outer system.

We had separation at 397 r distance. Saturn has an elongation of 41 r (away from the Sun); its mass is 3·345 times less than that of Jupiter. From this farther distance follows a greater approximation of the rotary flux reacting against more rapid transportation; the point of separation is brought $41\,r\sqrt{3{\cdot}34}\,r=72\,r$ nearer to the Sun, or $397\,r-72\,r=325\,r$, equal to the mean distance of Mars. The elongation of Jupiter is 53 r (nearer the Sun); it results a reaction against the slower translation of the exterior system, which brings the point of separation to—

$$53\,r\times3{\cdot}345^2+3448\,r=4015\,r,$$

equal to the distance of Uranus.

Mars is the projection of Venus by the elongation of Saturn, whose direct projection is Venus; Venus was driven 1·025 beyond its simple excentric position. With Mars, the projection of Venus, the proportion is reversed; it is repulsed by Saturn. We have—

$$\frac{176\,r\times1{\cdot}72\times1{\cdot}10\,r}{1{\cdot}025}=326\,r$$

as distance of Mars.

Mercury is the projection of the Earth, which is 1·22 times more distant than the point of gravitation; the solar distance of Mercury becomes—

$$\frac{176r}{1{\cdot}72 \times 1{\cdot}22} = 82{\cdot}8\,r.$$

A tertiary perturbation here becomes perceptible.

(To be continued.)

V. ON BRAIN-WORK AND HAND-WORK.

By R. M. N.

It may seem presumptuous in me to take up a subject which has been ably dealt with some years back in the "Journal of Science," by occasion of Dr. Beard's treatise on the "Longevity of Brain-Workers." Still it appears to me that the last word on this topic has not yet been said. Certain points, both of distinction and of resemblance, seem to have been overlooked as well by reviewer as by author, and certain of the conclusions drawn are at least open to question.

I may perhaps be allowed to put the opening question, What is work? The common reply is, "Any pursuit by which a man earns or attempts to earn a livelihood, and to accumulate wealth." This definition is the more to be regretted because it cherishes, or rather begets, the vulgar error that all persons who do not aim at the accumulation of wealth are "idlers." In point of fact such men may be doing far greater services to the world than the most diligent and successful votary of a trade or a profession. Darwin, having a competency, was therewith content. To him, and to others of kindred minds, the opportunity of devoting his whole life to the search after scientific truth was a boon immeasurably higher than any conceivable amount of wealth. Shall we call him an idler? Nor is Science the only field which opens splendid prospects to men of independent means. Art, literature, philanthropy, have all their departments, unremunerative in a commercial point of view, or at least not directly remunerative, and for all these cultivators are wanted. Therefore, reversing the advice given by routine moralists, I would say to wealthy young men of ability "Do not take up any trade, business, or profession, but do some of the world's unpaid work. Leave money-making to those who have no other option, and be searchers for truth and beauty." Everyone who follows this advice will contribute something to show the world that the race for wealth is not the only pursuit worthy of a rational being. I should define work as the conscious systematic application of mind or body to any definite purpose.

I said "of mind or body." Perhaps the expression may sound old-fashioned; so to avoid grating on the nerves of a monistic world I will say "of brain or muscle." But can we draw a sharp, well-defined boundary line between brain-work and muscle-work? Recent investigations into the functions of the brain show that it has the task of directing and co-ordinating muscular effort. The athlete, or say the musical performer, has not merely to strengthen his muscles and acquire flexibility of arm, hand, and finger; his exercises serve at the same time to develop and perfect those regions of the brain by which the muscles in question are actuated and co-ordinated.

Prof. Du Bois Reymond, in his admirable treatise on "Exercise" (reviewed some time ago in the "Journal of Science"), contends that "bodily exercises are not merely muscle-gymnastics, but also nerve-gymnastics," and that practice in the movements of the limbs is "essentially exercise of the central nerve-system." Hence muscle-work which is not at the same time brain-work is a chimera, which has no existence. But it will now be asked, Is there any brain-work without muscle-work? Undoubtedly; we may see phenomena, we may reason upon them, and come to a conclusion concerning their nature without any muscular action at all. But if we even wish to write down our results, or to tell them to a friend, some muscular action, small though it be, is needed. Or we wish to go further: not content with merely observing the phenomena which chance brings before our eyes, we go forth in search of facts. Here muscular-work is blended with brain-work. A step further: We wish to put definite questions to Nature, to perform physical, chemical, or physiological experiments. In all these cases the hand has to be the inseparable companion of the brain. The efficiency of the one will not compensate for inefficiency in the other. Now, the work of the experimentalist rarely requires great strength, but it invariably stands in need of delicacy, nicety of touch and movement, bodily or, if you will, muscular, attributes to be reached only by training.

It is the same in the fine arts. The painter needs not merely an exquisite perception of form and colour, an instinctive—as it appears to outsiders—appreciation of their relations and harmonies; unless he possesses in addition to all this the requisite nicety of touch, he must fail to embody in visible form the conceptions present in his brain. Precisely the same is it with the musician. The orator and the actor must also, in addition to their mere mental gifts, have vocal organs thoroughly developed and disciplined. Thus we see that in the highest walks of science and art, brain-work and muscle-work exist, I might say, in a state of interpenetration.

Again, at a work-table in Y—— Street, sits a microscopist, carefully studying the peculiarities of a newly detected microbion, or dissecting the larva of the Phylloxera. What is he? Brain-worker, or muscle-worker? You pronounce him a brain-worker; his brain, in your opinion, doing the larger—the essential part of his task. So be it. I convey you to X—— Street, where at another work-table sits a microscope-maker. He is accurately adjusting an objective of high power. What is he? Like the user of the microscope just mentioned, he requires the utmost delicacy of touch, the highest manipulative skill. Like the microscopist, also, his brain performs the essential part of the task. But you will probably call him a hand-worker or muscle-worker, because he is a mechanic!

Surely, then, we must admit that there is no hard and fast boundary between the brain-worker and the muscle-worker. There is no muscle-work without brain-work; there is little brain-work of a high order without muscle-work.

There are, however, gradations. There are kinds of muscle-work, so simple, so monotonous or uniform in their character, that they are, with very little practice, performed automatically, with no conscious effort of the brain. Such, for instance, is the work of the agricultural labourer in digging, mowing, thrashing, &c., or of the hodman carrying bricks and mortar up a ladder. All such work, it is generally found, can be performed by means of machinery. Perhaps this may enable us to find a definition, or rather a limit for muscle-work.

I must now ask what classes of society can rank as brain-workers. Dr. Beard seems to include here, clergymen, lawyers, physicians, merchants, scientists, and men of letters.

He does not make any mention of artists, teachers of different branches of knowledge, manufacturers, &c. Now, if the merchant, the man who distributes, fetches, and carries, is to rank as a brain-worker, surely must the producer, who much more frequently originates out of his own mind something new to the world. We may also ask, Does the term merchant include the retail dealer, the clerk, and the commercial assistant? If so, we find the brain-working class reinforced by a number of persons who certainly have little need for muscular exertion, but little also for brain-work, and many of whose tasks and duties might be performed by machinery. Again, where are we to place the speculator, the gambler, and the forger? Muscle-workers they are only to a very small extent, though the forger requires a wonderful amount of manipulative skill. He must, however, be regarded as a doomed species, since the Nesbit patent safety-cheque carries in it the germs of his destruction.

It becomes very difficult to say with accuracy who are to be classed as brain-workers, and who as muscle-workers, and, still more, who are to be referred to Dr. Beard's third class, "those who follow occupations that call both muscle and brain into exercise." This class, as I have endeavoured to show, includes almost everyone who works at all. Until we are able to furnish a correct classification of mankind as brain-workers and muscle-workers, it will be very difficult to enunciate any true and valuable proposition concerning either group.

Twenty years ago, Dr. Beard laid down among others the following set of propositions:—That the brain-working classes—clergymen, lawyers, physicians, merchants, scientists, and men of letters—live very much longer than the muscle-working classes. That the greatest and hardest brain-workers of history have lived longer on the average than brain-workers of ordinary ability and industry. That clergymen are longer-lived than any other great class of brain-workers.

The first of these propositions admits of statistical proof or disproof. The life-lengths of the classes of men above mentioned can be ascertained, and their average duration compared with the mean length of life prevalent in their times and countries. But is the superior longevity of these classes due to the fact that they are brain-workers, or must it not be traced to a complication of causes? If brain-work is *per se* salutary and conducive to long life—which I do not deny—and if, as we may gather from Dr. Beard's second proposition here given, its beneficial influence is proportionate to its intensity, we should find the men whose brain-work is devoted to origination stand highest in the list. As such I should undoubtedly rank discoverers in science, inventors in the industrial arts, poets, musical composers, and painters (not of portraits). But the third proposition entirely clashes with this conclusion. Dr. Beard tells us that of all brain-workers, clergymen are the most long-lived. Yet they can scarcely be called the hardest brain-workers, since what is demanded from them is not origination, creation, but expression. If a clergyman initiates new doctrines he is in danger of becoming a heretic. He is expressly forbidden to do what is expressly demanded from the man of science or the author. Indeed, till a comparatively recent date, the life of an English country clergyman has always been considered as one of the easiest of all careers, making no heavy demands either upon brain or muscle.

Indeed, Dr. Beard, when he undertakes a formal explanation of the great longevity of the clergy, makes some very important concessions. He remarks that "their calling admits of a wide variety of toil,"—"In their manifold duties their whole nature is exercised,"—"Public speaking, when not carried to the extreme of exhaustion, is the best form of gymnastics that is known." Dr. Beard here admits what I also maintain, that the most healthful work is that which duly and harmoniously calls into play all the various faculties of a man. Brain-work is in itself good and wholesome,—undoubtedly better than pursuits which exercise the muscles alone, leaving certain regions of the nervous centres inactive. But it is still inferior to work which exercises the entire system. Whatever calling effects this most thoroughly and equally, will be the ideal vocation. But it may be said that the duties of the physician call a wide circle of powers into play. Why, then, is he less long-lived than the clergyman? In his case there is wanting any physical exercise which may take the place of public speaking, and he is more exposed to death from contact with malignant disease.

As an instance of the especial benefit to be derived from an exercise of the whole system, I may glance at the lessons to be gathered from the experience of exploring expeditions in unhealthy countries. The first to succumb are porters, guides, muleteers, private soldiers and sailors, &c. Next come military and naval officers, whilst the doctor, the botanist, the geologist, &c., hold out to the last, their sole advantage being a more thorough exercise of the whole system, muscle and brain alike.

Dr. Beard gives another reason for the longevity of the clergy—their comparative freedom from anxiety. This is the critical point to decide whether brain-work shall be healthful or harmful. Let a man work knowing that his livelihood is secure,—that it is indifferent whether he completes any given task this month or this time six months,—and no amount of study will harm him. But tell him that he must complete some task by a given date under penalty of dismissal, or that his prospects in life depend on his passing an examination better than a score of competitors, and the probability is that his studies will bring on softening of the brain, heart diseases, or perhaps Bright's disease.

Dr. Beard formally admits that "worry is the one great shortener of life under civilisation, and, of all forms of worry, financial is the most frequent and the most distressing." Hence the differences between his views and mine are very much smoothed over, and we must take in a "Pickwickian sense" his declaration elsewhere that "brain-work is the highest of all antidotes to worry."

He brings forward yet another reason for the longevity of clergymen—"their superior temperance and morality." That such superiority, if it exists, will have an influence in favour of health and long life, I readily admit. But it is very doubtful whether they are in this respect superior to other brain-workers. In the career of the scientist mutinous passions are simply crowded out. For him the struggles with temptation, of which the ethicists tell us, have simply no existence. How it may be among those brain-workers who move in a more emotional sphere, I cannot presume to say.

Dr. Beard's contention that the brain-worker is, as a class, happier than the muscle-worker is very questionable. He asks, "Where is the hod-carrier that finds joy in going up and down a ladder, and, from the foundation of the world until now, how many have been known to persevere in ditch-digging or sewer-laying, or in any mechanical or manual calling whatsoever, after the attainment of independence?" Such persons, I think, might be found. Many of these manual occupations would, as far as I can judge, seem happier than a life spent at the merchant's desk or at the exchange. If the man of business "continues to work in his special calling long after the necessity has ceased," it is because he has been trained to believe that accumulation of wealth is the whole duty of man. "Nearly all the money of the world," says Dr. Beard, "is in the hands of brain-workers." This may be true; yet, at the same time, many of the hardest and most capable brain-workers rank among the very poorest. Young men are now warned by their friends to avoid the highest class of brain-work, and even to shun the learned professions, "because they do not pay." I meet with books containing the records of original research, yet for which the author has received less than the wages of a stone-breaker for the time employed. I meet with inventions which ruin the inventor and enrich his followers. Verily the manual labourer has scant cause to envy the brain-worker.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 97.)

ONE of the distinguishing features in the Educational System in Germany is the definite school system which is carried out in every part of that kingdom, under a fixed order of administration. This complete and perfect organisation of the different educational institutions in that country astonished the French Commissioners.* They say in their Report—"The most striking characteristic of the German institutions for national education is the general whole—the arrangement of all the establishments, which, from the primary school to the highest faculties in the university, offer the different classes of citizens a series of degrees of instruction which they may need or have the capacity to acquire."

Our school system, on the other hand, if it can be called one, is altogether unorganised; it is in a chaotic state, and yet it must be admitted that any national system of education—to be efficient—must be arranged on some well understood plan in which the object to be attained must be kept steadily in view from the very first. But of all our unorganised, aimless, objectless systems, the Science one under the Department of Science and Art appears to me to be the worst. A gentleman to teach under the Department must have obtained the Department's qualification to teach; but when he has obtained it, as he receives no payment from the Department except by results, he can start classes, and teach the pupils what sciences he pleases without regard to any plan or unity: he will teach those subjects only which will pay him the best in the place in which he establishes a class. He may teach, for instance, one year a class in elementary chemistry; next year he may teach, in the same place, if he thinks it will pay him better, elementary botany; in the third year, elementary geology; and so he may go on through the whole circle of the sciences, if he thinks he can get a sufficient number of students to attend in the different subjects. His sole aim will be to get as much money as he can on the result system, and he knows that to attain this he must in many places vary his subject from time to time: he further knows that as a rule he can obtain the most money by preparing his students for examination in the elementary stage of the subject only; in the majority of cases it will not pay nearly so well to go higher than the lowest stage. The taught will thus only acquire a smattering of the rudiments of one or more of the sciences, which will not prove a source of pleasure or profit to the majority of them, and such a system of science teaching can never be of any advantage to the nation industrially; and we can only expect to maintain for our manufactures a foremost position in the markets of the world, in the present day, by at least our middle class obtaining on an *ascending* scale of instruction in Science, as is done in Germany, a high class scientific education.

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* In 1862 the French Government appointed a Commission to visit Germany and other countries for the purpose of collecting the most precise information with regard to the systems of education adopted in the different countries they visited. The Report the Commission drew up on the subject the English Government afterwards had translated and published in the form of a Blue Book.

We shall bring under review, as we proceed, the number of students attending the elementary science classes under the Department of Science and Art, the number that pass, and the cost to the State of these classes: it will then be apparent that only a very small percentage of the students attending these classes go in for the higher examinations; but for the purpose of more forcibly illustrating what is about to be stated with regard to the *defects* of the system of teaching which has to be adopted by the teachers of these classes, I will here give the number of examination papers issued, and the number of successes, at the May examination in 1881. I give the number of papers instead of the number of *individual* students, because it is difficult, if not impossible in some cases, as I shall show further on, to arrive at the number of individual students, owing to the manner in which the returns are given in the Department of Science and Arts Reports. The number of papers does not of course represent the number of individual students,—as a student may, and frequently does, go in for examination in several subjects, and he is furnished, of course, with a separate examination paper for each subject.

At the May examination, 1881, 72,300 papers were issued. The total successes amounted in round numbers to 67 per cent: of this total of successes 53 per cent passed, including both classes, first and second, in the elementary stage; 13 per cent passed, including both classes, in the advanced stage; and 0·7 per cent, including both classes, in the honours examination.

Teachers who prepare pupils for competitive examinations must teach the subjects of instruction in the way that will best prepare their pupils for the class of questions the examiners will be likely to give; but when the teacher's payment also depends, as it does under the Department of Science and Arts system, on the pupils passing, the teaching becomes completely and absolutely subordinated to the examinations. The teacher is entirely precluded from displaying any individuality in his teaching; he cannot teach his pupils according to their individual wants and capacities; he must teach on *the one groove* that will best prepare them for the examiner's papers. This evil system—for it is an evil one—is still further increased by the examinations as well as the administration being completely centralised. This system of examinations and competitions on the great scale is illustrated in China, "where it *has produced a general and incurable senility*." But we need not go so far as China to learn the ill effects of the system: we need only contrast two neighbouring nations, France and Germany, to learn the different influence on a nation,—whether the teaching is subordinated to examinations, as it is in France, or the examinations are subordinated to the teaching, as it is in Germany. The effects of these two different educational systems was strikingly shown in the Franco-German war: the officers and the men in the one army had been educated under one of the systems, and the officers and men in the opposing army under the other. "The unanimity," states the Right Hon. Lyon Playfair, in his pamphlet on Teaching Universities and Examining Boards, "is surprising with which eminent French men ascribe the intellectual paralysis of the nation to the *centralisation of administration and examination*." And a like system must produce the like ingenious results to a nation to whatever grade of education it is applied. The late eminent French chemist Ste.-Claire Deville said—"The success of Germany is due to the liberal organisation of the German Universities. It is Science that has vanquished us." Renan, whose opinion I have given with regard to the effects of examinations and competitions in China, that they had produced a general and incurable senility, said—"In France we have already gone far in the same direction, and that is not one of the least causes of our abasement." The French provincial universities were destroyed by the great Revolution. Napoleon I. reconstituted the University of Paris in 1808, by making it the single university for France. "He did this," to employ Dr. Playfair's expressive words, "with the power of a military despot, and *with the professional instincts of a drill-sergeant*. The University now became the Department of State Instruction, and included every kind of education—primary, secondary, and collegiate; while Germany was multiplying its universities and establishing among them a most salutary emulation."

It is admitted by all sound educationists that it is far more important in the training of the mind to adopt the best methods of teaching than what subjects are taught,—in other words, how we teach is far more important than what we teach; but under such a system as that of payment by results the teacher cannot be an educationist; he can only be a crammer, and this is confirmed by the multitude of books on the different sciences which have been published since this system was adopted by the State: the books to which I refer, or at all events the vast majority of them, are purely and simply cram books; but the teacher finds that these are not always sufficiently attenuated to enable him to prepare with any success his pupils for the examination: he therefore either writes out answers to the examination papers that have been given for several years past on the subject he is teaching, and makes his pupils commit these answers to memory, and practises them by asking a certain number of the questions each time they meet and making them repeat from memory the answers,—or he selects the book on the subject which he considers to be the examiner's *pet one*, and he guts it, and condenses the necessary information for the examination into a sheet of letter-paper, along with the illustrations of the apparatus required for the experiments; he has this printed, and he supplies or makes each of his pupils buy a copy, and they have to commit the contents to memory.

Our representatives in Parliament vote each year a considerable sum of public money for the propagation of this unmitigated cram, under the misnomer "for teaching Science." Prof. Huxley has stated that "we study in these days *not to know, but to pass*, the consequence being that *we pass and don't know*"; but of all the systems that contribute to the extension and propagation of counterfeit knowledge, that of the Department of Science and Arts certainly excels every other. For by this system the majority of the students are not taught to observe and experiment themselves, and to state and reason on the results they have obtained, and yet observation and experiment are the sources of our knowledge of the Inductive Sciences; they are the most important and indispensable qualifications a student of these Sciences ought to possess. Instead of obtaining, as all students of Science ought, a "knowledge of things," which can only be obtained by observing and experimenting, the Department's students, owing to the system, only acquire the spurious article, "the names of things."

I believe we commence on a wrong and erroneous system for teaching some of the Sciences, especially Chemistry, and the Germans are no exception to the rule; we commence by teaching the facts of the Science by means of lectures. Even if the pupils could remember all the facts they are told in lectures it would be mere information, not knowledge, still less Science; if a student committed all the facts contained in Gmelin's great work on Chemistry to memory, it would not make him a chemist, for it would only amount to information. Hunter, in his "Principles of Surgery," has very succinctly stated the essence of all true teaching: he says "that his object was to fit his pupils to act as occasion may require from comparing and reasoning on known principles. Too much attention," he goes on to say, "cannot be paid to facts; yet too many facts crowd the mind without any advantage, any further than they lead to principles." "These words," states Prof. Humphry, "give the very marrow of sound teaching, and should be graven wide and deep on the walls of every school, and in the heart of every teacher. They have, alas! been too little heeded."

A person totally ignorant of Chemistry may be trained to perform mechanically certain chemical operations, as a man can be taught mechanically to work a steam-engine: the porter in a chemical laboratory, for instance, may be taught to prepare or purify certain compounds; boys, without the least acquaintance with the science, are frequently taught in chemical factories to analyse quantitatively the substances manufactured in the particular factory to which they are attached, but they may—and, as far as such training goes, will—remain ignorant of a knowledge of the principles involved in the preparation or analysis of the substances on which they operate. But even this kind of information is superior in point of utility to mere verbal information, whether derived from a teacher or a book; for in the one case the party is able to accomplish something, whereas in the other case all that is possessed is merely the *names of things*, and, if this forms the *alpha* and the *omega* of the teaching of an experimental science, such information can never prove of any practical benefit to the taught, or to the State which has paid for such instruction. The late Prof. Augustus De Morgan made some appropriate remarks on this spurious knowledge in a letter he addressed, in 1853, to Prof. Michael Foster, in which he stated the objections he had to the system pursued in the London University. "For example," he states in the letter, "a candidate for the B.A. degree is required, in addition to matters which enter the ancient disciplines, to be examined in *animal physiology*. And he may pass this examination without knowing more, from his own observation, of what is under the skin of any animal, than he learns from the words of a book or the lines of a drawing which no one can understand except he be familiar with the original object. I will venture to say that a large majority of those who have passed the examination in physiology know nothing about the interior of the body, from their own observation, except that blood follows a cut in the finger. I appeal to the examiners whether it be not as I say, and whether the answers given do not clearly show it. Thus, for the first time in the annals of liberal education, a University has proclaimed that mere words, as words, with no meaning attached, are a worthy discipline."

Authors of educational works on, as well as teachers of, Science, too frequently overlook or forget that "the knowledge a man can use," as Mr. Froude has remarked, "is the only real knowledge, the only knowledge which has life and growth in it, and converts itself into practical power. The rest hangs like dust about the brain, or dries like rain-drops off the stones."

I have stated that I believe—and I speak with some considerable experience—we commence the teaching of some at least of the Sciences, especially Chemistry, on a wrong and erroneous system: instead of teaching detached facts, as is generally done, I would teach—along with exercises on the language of the Science, and what are now termed the arithmetical problems—as thoroughly as possible the conditions under which combinations and decompositions take place. This method I made known in one of my works, "The First Step in Chemistry." The arithmetical problems have been almost universally adopted in the teaching of the Science in these countries, and also in America : the teaching of the language as laid down in my work has also been followed to a certain extent ; but the plan of teaching the experimental portion of the Science by elucidating, by means of suitable experimental facts, the conditions under which combination and decomposition take place, has not been followed to any extent in these countries : and yet it is not only a very important part of my system, but it is more in accordance with the principles of all sound teaching than the one which is substituted for it ; for whilst the information the students obtain by the latter system is mere empirical knowledge, by my system *reason*, *language*, and *observation* are cultivated together, and therefore the mind is disciplined for thought and action. It is as successful and efficient as a discipline for the mind with boys as with young men, and I have found, in the rather large experience I have had in practical working in different kinds of chemical factories, that many processes fail or work badly although correct in principle, owing to those who have the management of them not knowing or discovering the proper conditions for working them successfully.

(To be continued.)

ANALYSES OF BOOKS.

Upilio Faimali; Memoiren eines Thier bändigers. Gesammelt von PAUL MANTEGAZZA.* Leipzig and Heidelberg: C. F. Winter.

POSSIBLY some of our readers may feel surprised that we should select the memoirs of a tamer of wild beasts for notice in the "Journal of Science." We trust that the important observations in zoology and animal psychology made by our subject will fully justify our choice. Upilio Faimali was one of tbe earlier of those performers who travel about with caravans of wild beasts, and who minister to public curiosity by entering the dens of lions, tigers, leopards, &c., engaging in mimic combat with these monsters, and compelling them to perform a variety of tricks. The taste for these exhibitions Prof. Mantegazza rightly pronounces a survival—the last remnant of the taste which led the most delicate ladies of Ancient Rome to gloat on the savage games of the circus. So far is this instinctive blood-thirstiness from being eradicated that nothing save the Law prevents combats of wild beasts and gladiators from being revived in our unco' good humanitarian and bestiarian England. On reflection it does indeed seem strange to see a community suppresing by their united action what a majority of them in their hearts approve of, and, conversely, compelling by law or custom what they individually dislike. Of such action the instances are not few.

Upilio Faimali was an Italian,—a son of the nation which supplies the world with professional athletes. We may ask if this aptitude for performances requiring strength and agility is not an inheritance of the physical training which for so many generations characterised the ancient Romans more than any other people of the past or the present?

Be this as it may, Faimali was from a very early age distinguished for muscular power, activity, courage, and presence of mind. In his eleventh year he obtained an engagement in Didier's circus, and five years afterwards he astonished his employer and delighted the public with the equestrian performances of an ape which he had trained in secret. From that time his rise was rapid, and he soon possessed a menagerie of his own, with which he visited the chief cities of the Continent, and was everywhere successful. His adventures and his hair-breadth escapes we must pass over, mentioning merely that his favourite dressing for wounds was a mixture of finely pounded sugar and brandy. But we turn with especial interest to his observations on the various animals which were for so many years his constant and close companions. The first point to be noted is one which bears upon the distinct nature of species. Many experiments at hybridisation have, we know, failed, the young half-breeds produced being brought into the world dead or surviving but for a short time. But so greatly is the reproductive power of many animals affected by changes of climate, of diet, and other conditions, that their young of unmixed blood, born in captivity, rarely survive. Faimali had about eighty lion-cubs born in his menageries, but none of them survived beyond the third or fourth year. Young leopards generally died before the end of their first year, or became paralytic. The young of many other species are weak, and suffer from rachitis. A singular fact is that the mother often kills the young brood, or at least refuses to suckle them, unless kept in darkness for several days after their birth. This circumstance is noted in the case of the hyæna, the wolf, the lioness, the panther, and the tigress.

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* Upilio Faimali; Memoirs of a Tamer of Wild Beasts. Collected by PAUL MANTEGAZZA.

In docility, intelligence, and disposition towards mankind the large Carnivora differ greatly. The leopard is probably the most docile and affectionate; the jaguar less easily trained, and probably a more dangerous playfellow than any other member of the cat family: it cannot easily be made to let go whatsoever it has once seized.

In one and the same species Faimali recognises individuality as distinctly as in man. The degree of docility depends, according to him, upon the varying power of attention. The education of beasts should not be undertaken too early; a lion learns best in his third or fourth year. If taken in hand too soon he becomes confused, and is spoiled. It is remarked that lions from the Cape are cleverer and more docile than those from the Sahara or Senegambia.

The hyæna is pronounced to be the most stupid of all the animals exhibited in menageries; "it shows no attachment to its keeper, no gratitude for kindness, learns nothing, and is influenced only by fear."

Faimali possessed a very large white bear, but never entered its cage, as it never would obey him. With the black bear of Europe he often went through his performances, sometimes not without danger. We do not learn that either he or any of his contemporaries or successors ever attempted to tame a "grizzly." We suspect this would prove a desperate undertaking.

Faimali's observations on apes and monkeys are in conformity with the views of the New School. He considers the chimpanzee the most intelligent animal which came under his observation. He notes that he never saw one of this species "perform the last stage of digestion" in public. This is an instance of decency superior to that shown by many of the human race, and contrasts glaringly with the conduct of apes of the baser sort, from whose actions even Till Eulenspiegel might have learnt new lessons in impropriety. Faimali notices also the intense attachment of monkeys and baboons for their mates: the male and female often die of grief if separated.

Animals of the cat-family, if born in captivity, suffer much when cutting their teeth. Those caught wild are apt to perish of pulmonary consumption, a disease which is still more common among the Simiadæ, and which, curiously enough, generally terminates the career of the trainers and keepers of wild beasts.

In opposition to many high authorities, Faimali pronounces the lion stronger than the tiger, though the latter is more agile and uses its canines with greater skill. The two species rarely agree together.

The little work before us well deserves the study of the naturalist, the more because the large Carnivora are evidently and of necessity doomed to extirpation, and because a prolonged study of their habits is thus becoming from decade to decade more difficult.

The Remote Antiquity of Man not proven: Primeval Man not a Savage. By B. C. Y. London: Elliot Stock.

The author of this work is evidently a laborious reader. There are few authorities bearing upon the subject which he has not taken into consideration. Even stray paragraphs in newspapers have not escaped his attention. Nor can it be denied that the subject of his inquiry is at once legitimate and of profound importance. But we can by no means feel satisfied with the spirit he displays. An investigation into the antiquity of mankind ought surely to be taken with judicial impartiality. B. C. Y. evidently has a strong bias in favour of traditional notions as against the results of modern research. Any rumour of evidence for the high antiquity of our race is to him a "scare." He argues throughout like a barrister who, in dealing with a mass of circumstantial evidence, seeks to put upon it any and every interpretation consistent with the interests of his client. He seems to be under the impression that if the various facts hitherto adduced in favour of man's existence upon earth for untold thousands of years can be held up us questionable or indecisive, we shall then have to go back to the conventional chronology of some 8000 to at most 10,000 years. This seems to us a most serious error. If all the conclusions of geologists, drawn it must be remembered from the actual inspection of the phenomena, and not at second-hand from mere reading, are insufficient, the utmost that can follow is an admission that the antiquity of man is totally unknown. B. C. Y. has not a particle of evidence to show definitely and positively the non-existence of man, say 20,000 years ago. He relies on traditions. We must rule that on such a subject the traditions of ancient nations are no more receivable in evidence than would be the alleged testimony of an individual man who should profess to tell us, of his own knowledge, the history of his early childhood. There is an *à priori* objection to brachy-chronology, as the late Mr. Gosse called it ; it is one of a bundle of notions on the earth, on man, and on his surroundings, held in the pre-scientific ages. Most of these notions proving to be false, in as far as they have been brought to the test of observation and experiment, we may fairly expect that the same will be the case with the rest.

We are curious to know what the author would say concerning the foot-prints recently discovered at the Carson State Prison ? Would he accept them as conclusive, and strike his flag ? Or would he seek to deny their antiquity, or their human origin ?

We may believe that the earliest men were not savages when we can find a child born fully versed in the sciences and arts, and not requiring education.

The author's remarks on the formation of the different races of mankind by the action of climate, including a quotation from Buffon, are not very happy. Complexion is not the characteristic of races, nor is it dependent upon climate. The native race of America shows the same complexion in all latitudes. We are told of the black Jews in Cochin ; but these Jews are in features, shape of skull, and general structure no step nearer the Negro type than are their fairer kinsmen in Northern Europe. Again, if the Negro has—as the author substantially admits—undergone no marked change in the last 3400 years, what length of time, we ask, would be necessary for his differentiation from the white race ?

At the very close of the book the author formally declares war against Evolution, so far at least as Man is concerned. He declares that the transformation of any brute into man could not have occurred " without some of the intermediate nondescript forms being discovered." This is a hazardous assertion. We can infer little, if anything, from the silence of the great stone book.

There is a further point to which we must draw attention : the author declares himself not hostile to Science ; but Science, according to him, must consist simply in noting and chronicling facts. We must not theorise. But a mere catalogue of facts, not to be explained or co-ordinated, is not Science. Indeed it is hard to say where pure observation ceases and where inference begins. Alike in Science and in common life, the two are blended in a manner which almost defies extrication.

B. C. Y., unfortunately, is one of those who still reject the luminous principle laid down by Galilei, that in astronomy and physics, and in like manner in geology and biology, the Scriptures merely embody the current notions of the day when they were written, and can claim no scientific authority whatever.

*Reinhold Buchholz Reisen in West Afrika, nach seinen hinterlassenen Tagbüchern und Briefen, nebst einem Lebensabriss des Verstorbenen.** Von CARL HEINERSDORFF. Leipzig: F. A. Brockhaus.

We have here to call the attention of our readers to the career and the researches of a most able and promising naturalist, lost to Science at the early age of 39. In his earlier history we find much which powerfully excites our sympathies. He was, so to speak, a born student of nature, and especially a zealous entomologist—not, be it understood, like so many boys, a mere collector, but an intelligent observer. He was, too, like ourselves, in early life an enthusiastic admirer of Oken, whose works he eagerly devoured. Both in his home at Juditten, a district famed for the richness of its flora and insect-fauna, and afterwards at the house of his guardian, Herr Becker, in Königsberg, where he became a pupil of the local college (Gymnasium), he enjoyed full opportunity for the prosecution of his favourite pursuits. Unhappily, his guardian, a government official, was transferred to Berlin, and placed young Buchholz in the Jaochimsthaler Gymnasium of that city. This was the most unhappy part of his life. He was not understood either by his companions or by the heads of the institution. It was, apparently, one of those narrow, Procrustean establishments, less common in Germany than in England, where the individuality of the pupils was ignored, aud where one inflexible curriculum was imposed alike upon all. The occupations of the boys even in the hours of leisure were, as far as possible, brought under an Act of Uniformity, in a manner that reminds us of the compulsatory foot-ball and cricket in some of our English public schools. As an incipient naturalist, he was regarded as a black sheep, and some disorder having occurred in the establishment, he was advanced to the rank of scape-goat, and expelled without a particle of evidence. This injustice was, in reality, fortunate. He returned to Königsberg, where the head-master of the Collegium Fridericianum understood his disposition, and where he soon became the pride and the ornament of the college. Here he gained the friendship of Dr. Julius Schumann and Professor Zaddach, both naturalists of merit, whose intercourse greatly contributed to the development of his mind. At the age of twenty he began his medical studies at the "Friedrich Wilhelm Institut," at Berlin. Here he was also employed by the brothers Schlagintweit, to assist them in classifying the rich botanical treasures which they had brought home from Central Asia. He did not, however, remain longer than five terms at the Friedrich Wilhelm Institute, as each term bound him to a year's service as medical officer in the army. In his twenty-fourth year he graduated as Doctor of Medicine, his inaugural dissertation being "De Periostei Transplantationibus." In preparing this thesis, physiological experimentation was necessary, and some of our modern zoophilists will doubtless be disposed to read the commination of Ernulphus over his grave if they learn that during the summer vacation his mother's house was a perfect hospital of dogs and rabbits which had undergone operations. His next work was a contribution to helminthology—the anatomy of the genus Enchytræus, with a notice of the species occurring near Königsberg. In this memoir, according to Professor Langlois, he proved himself an expert dissector, an acute observer. and an excellent microscopist. But we must hasten on, briefly noticing the remission of his five years military service—a special act of royal favour,—his histological researches on the nervous system of the Mollusca, his appointment at the Zoological Museum at Greifswald, his obtaining the second degree of Doctor of Philosophy, his journey to Naples, where he spent three months chiefly in the study of the Crustacea, and discovered seven new species. In 1869 he took part in the second German polar expedition, and underwent severe hardships by the wreck of the Hansa, when his collections, drawings, note-books, and instruments were lost. Here he appears to have suffered from serious nervous disease. On his recovery he undertook the arrangement of the collections made by Dr. Pansch, the naturalist on board the more fortunate companion-ship, the Germania. In 1872 he received the appointment of extraordinary Professor of Zoology at the University of Greifswalde. In June of the same year he undertook, in company with Dr. Lühder and Dr. Reichenow, his last and most brilliant journey to the Gold Coast, the Mountains of Camaroons, Fernando Po, the Gaboon, and the Ogowi. The expedition was most successful, and in 1875, Buchholz returned to Greifswalde richly laden with treasures. In January, 1876, he was appointed to the ordinary Chair of Zoology at the University, and the Directorship of the Museum. But his end was near. His constitution, never apparently very strong, had suffered much from the climate of equatorial Africa. A violent cold developed into inflammation of the lungs, and on April 17th his short, but most honourable, career came to an end.

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* Travels of Reinhold Buchholz in West Africa, from his Journals and Letters, with a Sketch of his Life.

We turn, now, to his African expedition. His observations on the marine fauna began even in the North Sea, and were continued most of the way. The vessel sailed too swiftly to admit of dredging or netting, but by pumping up sea-water and straining it through fine cloth, he succeeded in obtaining a frequent supply of small, but often highly interesting, Crustacea.

He notes that the flying-fish during their flight often changed their direction and effected striking movements. He considers that they accomplish these evolutions by touching the water in their flight and steering with the tail.

On landing at Akkra, Dr. Buchholz, like most naturalists who for the first time set foot in a tropical country, was delighted with the large and splendid butterflies, the large brilliant wasps belonging to the genera *Pepsis*, *Sphex*, *Pelopous*, &c. He found, however, great difficulties in the preservation of his specimens. A small fly pertinaciously tried to lay its eggs in the insects. Swarms of ants put in an appearance, whilst if the boxes were closed the contents became mouldy. This shows the necessity of having at hand proper poisons to spoil the appetite of marauders. The Termites were an especial object of our traveller's investigation. Many large hills which he broke open were deserted by their original inhabitants, but peopled with various wasps, bees, ants, spiders, &c. An occupied hill was found to contain workers, and two kinds of soldiers, large and small, but neither queen nor brood. A violent attack of fever put a temporary stop to the researches of Dr. Buchholz. He was told that this early attack was a good sign, as those who were not seized with the fever until later were in much greater danger. He resolved, however, to penetrate further inland to the village Aburi, situate on a hill about 1200 feet above the sea-level. On the way he found a "fabulous" wealth of insects, especially magnificent butterflies of numerous and often novel species. Scarcely less striking was the flora which displayed wonderful ferns, climbers, magnificent palms, and other huge trees, many of them covered with huge splendid flowers. At Aburi the climate was healthier, and the air drier, so that Dr. Buchholz had less trouble with his specimens. He points out as an error the common notion that the indigenous negroes are proof against the fever on the low coast-lands. They, too, are often attacked, though, as might be expected, less severely than strangers. The coffee plantations are much damaged by a "boring worm," probably a larva. Parrots, monkeys, &c., were scarce, but insects were found day by day in astonishing variety. Hence, whilst Buchholz remained for some weeks at Aburi, his companions, whose main object was ornithology, returned to the low grounds. He paid much attention to the driver-ants, two species of which at times do no little damage. They have been known to kill and partly eat a sheep which had been tied fast, to scare serpents out of their holes, and to turn out the entire congregation from the Mission Church. Like the termites, the drivers have large-headed soldiers as well as workers. A yellow species of ant, belonging to the *Myrmicidæ*, makes its nest of green living leaves. Buchholz watched them rolling up the leaves and cementing them together with a white silky matter proceeding from the mouth. The termites were of a smaller species than those at Akkra, and their nests did not exceed 2 feet in height. They have two kinds of workers, and only one kind of soldiers with unsymmetrical mandibles. The queen's cell was not larger than the other cells. In no instance could Buchholz find a king, or two queens in the same nest. From Aburi he was able to send home no fewer than 700 butterflies. It appears that the natives have already adopted the Eucalyptus as a remedy for fever. After his arrival at Camaroons, Dr. Buchholz found it necessary to separate himself from his companions, Lühder and Reichenow.

Among the Duallas, Buchholz remarks the frequency of albinism, which sometimes occurs in patches, producing a piebald appearance. He considers it a mistake to pronounce the negroes of this coast as defective in the calf of the leg. He finds them, also, by no means very prolific. It is rare for a woman to have more than two children.

The price of a slave at the time of his visit was about £1. He considers that slavery and the slave-trade have not been called into existence by the necessities of European colonies in hot climates, but are original phenomena, connected with the very nature and character of the black race.

Whilst at Victoria, which he paints in no very pleasant colours, Buchholz made a careful study of *Chamæleo superciliaris*, *Owenii*, *cristatus*, and *montium*, the last mentioned being new to science. The district swarmed with splendid butterflies, beetles of the curious family Cassididæ, robber-flies (*Asilus*), dragonflies, &c. But, whilst collecting and studying these creatures, he was himself studied by the most offensive mosquitoes (*Simulium*), sandflies small as dust, but occasioning intense torture, and Glossinæ, a form bordering on the redoubtable Tsetse of South Africa. Unfortunately the author had not the opportunity of anointing himself with kerosine oil, which several American naturalists have found very effectual in keeping blood-sucking flies at bay. Spiders were remarkably scarce. Almost the only ones seen were small hunting-spiders. Several new Batrachians were observed, especially a species of the genus *Plantymantis*, hitherto found only in Australia and the Malayan islands. *Chiromantis Guineensis*, a large brown tree-frog, deposits its spawn in frothy white masses upon the leaves of trees, in which the larvæ make their appearance.

Whilst at Victoria he experienced many attacks of fever, and was rarely well. He found the decoction of Eucalyptus of little value. Mention is made of a poisonous serpent (*Atractaspis*); it is about seven feet in length, and of a black colour, and occasions much damage. In the beginning of the year 1873, Dr. Lühder died, and Dr. Reichenow, shattered in health, returned to Europe, so that Buchholz remained alone.

Among the customs of the Bakhwiri tribe particular emphasis is laid on the witch-trials. If a person of note has died a natural death, or has been killed by a leopard, a death-snake, or a crocodile, someone is accused of having bewitched him, and is tried by ordeal with a decoction of the poisonous sasha-wood.

Among the vegetation of Bonjonjo he remarks the beautiful ferns and orchids, and a large Calla which flourished in every swamp.

Dr. Buchholz was induced by Lieutenant Grandee, of the English Congo Expedition, to try Dr. Günther's method of preserving birds without skinning. The entrails are removed, and the body filled with dilute carbolic acid, 1 part in 20. The process did not prove successful, as the feathers generally became loose before the body was dry.

On the Gaboon it was found that the sand-flea of South America (*Nigua*) had been successfully acclimatised, and was becoming a great nuisance. It appears that the natives make use of a curious poison. The teeth of venomous serpents are boiled up, and the juice is mixed with a powder, as Buchholz believes, some form of strychnin. Fine wooden needles are dipped in this poison, and a slight scratch or puncture with these is fatal. This statement confirms the view that the venom of serpents is a chemical individual, and not a ferment. Dr. Buchholz describes a nest of termites, which contained not fewer than three distinct species of termites, and four kinds of ants, which, when the nest was broken open, attacked the termites. The mutual relations of these different species constitute an interesting but difficult problem. In the same nest were many wood-lice, coleopterous larvæ, scolopendras, &c., and to complete the whole a swarm of wandering ants appeared, burst into the nest, and re-appeared, carrying off numerous termites as booty.

Shortly before his departure from Africa, Buchholz had the rare pleasure of making the acquaintance of a living young gorilla. It was of a more phlegmatic melancholy character than other specimens which have been taken alive. A remarkable point was that the animal, in striking at or grasping at anything, always turned the palm of the hand upwards. Whether it was disposed to strike outwards, centrifugally, or only inwards, as do the Felidæ, Dr. Buchholz does not say. It showed little inclination to climb, and was in fact clumsy. When sleeping it assumed perfectly human attitudes.

But our space is exhausted. We have not been able to notice even in the most superficial manner, one-tenth part of the important observations and discoveries made by Dr. Buchholz. No naturalist, we feel sure, can read this book without profound regret that the career of so able and accomplished an investigator should have been brought to an untimely end, and without, in spirit, depositing a spray of laurel upon his tomb.

Palæozoic Rocks of Galway, and elsewhere in Ireland, said to be Laurentian. By G. H. Kinahan, M.R.I.A., &c. (From the Scientific Proceedings of the Royal Dublin Society.)

For some years a difference of opinion has existed as to the age of certain palæozoic rocks in Donegal, Tyrone, Mayo, Wexford, and in other parts of Ireland. Jukes and King refer some of the rocks in question—among others those of the celebrated "Twelve Pins of Connemara—to the Laurentian Age. T. Sterry Hunt, twenty years ago, admitted that some of the Donegal rocks seem lithologically identical with the Laurentians of America, but that other rocks from the self-same area "cannot be distinguished from altered palæozoic strata in America more recent than the Laurentians."

The author now took up this question, and enumerated various palæozoic rocks in Ireland approaching the Laurentians in their lithological characters, but being otherwise similar to the more recent Huronian strata of America. In the memoir before us he shows the deficiency of proof as to the alleged Laurentian Age of the Irish rocks in question. If the strata in question are Laurentian, many others, admitted on good evidence to be of Cambrian, must be relegated to the same group. Not without reason he accuses the Laurentianists of laying too great weight upon lithological characters, and too little upon stratigraphical evidence.

As far as can be learnt from the memoir before us, and of the accompanying plates of sections of the Twelve Pins and of the Corcogemore Hills, we must consider Mr. Kinahan perfectly justified in the position which he assumes, namely, without asserting that there are no Laurentian rocks in Donegal, he maintains that conclusive proofs of their existence are still wanting.

Longman's Magazine, No. IV., February, 1883.

This number contains two articles on scientific subjects. Mr. Grant Allen discourses on a "mountain tulip" (*Lloydia serotina*), and draws lessons from its peculiar distribution. These lessons, however, would make no impression upon a votary of the Old Natural History, who should maintain that the flower had been specially created in all the situations for which it is adapted. We heartily agree with him in his regret at the extirpation—approaching or already effected—of not a few of our rarer plants. This catastrophe is due perhaps more to dealers in plants than to botanists properly so-called, though among them not a few may be accused of greediness.

Mr. R. Proctor communicates a paper on "The Photographic Eyes of Science," or, in other words, on the use of photography in astronomical research.

"A Farewell Appearance" is "a dog-story for children." If its author were so disposed he might write a true and sadder dog-story,—of a little girl at Crouch End who has become hopelessly mad from fright caused by a dog jumping at her in the street, and who, in one of her paroxysms, lately tried to kill a younger sister with a knife. The story, however, would not be for children, but would be an appeal to the conscience of dog-worshippers.

Reasons demanding an Answer. An Inquiry into the Basis of what is commonly called Christianity. London: W. P. Collins.

An examination of this little work does not come within the province of the "Journal of Science."

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SPEECH IN ANIMALS.

To the Editor of the Journal of Science.

Sir,—I have read the article on this subject in the January number of the "Journal of Science" with considerable interest, especially as the idea of civilising monkeys by the hereditary accumulation of training influences was suggested to myself some years ago by the following rather instructive incident:—

Visiting the monkey-house of the Zoological Gardens I was much struck with the remarkable frontal development and intelligence of expression and conduct of a small monkey,—so much so that I sought out the keeper in order to obtain information respecting the species and habitat of the specimen. He told me that it *was born in the monkey-house*, and if I remember rightly he spoke of it as the only instance of such birth; but of this I am uncertain. It died shortly afterwards, probably of consumption, which kills so many of the imported animals.

This case shows the possibility of breeding monkeys in confinement, and justifies me in making the following suggestion:—Let a careful selection be made of well-matched healthy pairs of *gentle* monkeys, and, instead of shutting them in cages, give them the range of a sub-tropical conservatory like the Palm House at Kew Gardens, but feeding them from the hand, and otherwise promoting that personal attachment to man which has so much influence in developing the moral and intellectual powers of the lower animals,—a development which in man we call "civilisation," in animals "taming," but which is virtually the same in both cases.

As an example of the possible docility and affection of such animals I may describe a case which I now have continual opportunities of observing. My friend and neighbour Dr. Branthwaite, of Harlesden, had a small monkey from Penang given to him about eighteen months ago. It lives in his consulting-room during the greater part of the day, and sleeps in a hutch in the adjoining surgery.

This animal has all the affection and gentleness of a lap-dog. He sits on his master's lap or shoulder, and cries pitifully if driven off and when the doctor goes out. He is similarly attached, though less strongly, to all the other members of the family, excepting the baby, which, when nursed and fondled, becomes an object of jealousy. One favourite mode of displaying affection is to rest his face in the hand, and look up to the eyes of the object of his love, with a ridiculously sentimental spoonyish expression.

I need not describe his tricks and other indications of intelligence, but name the above to show that there is no difficulty in obtaining monkeys that may safely be allowed the range of suitable places of public resort; that a monkey-house might be specially built and furnished with suitable growing trees in such a place as the Zoological Gardens, the Crystal Palace, or the projected Winter Garden at Brighton, and kept warm by stove-heat during winter; and that such a house might be stocked with a moderate number of pairs of gentle monkeys, where, having the opportunities of exercise suited to their natural organisation and habits, they would have a fair chance of propagation such as the present caging must tend to suppress, especially in animals of their extreme sprightliness and activity.

It would probably *pay* from a "show bisniss" point of view, as the unfettered gambols and "flying trapeze" exploits of these nimble and grotesque creatures would be very amusing, and the interest attached to their possible progeny would render the certified babies very valuable.—I am, &c.,

W. Mattieu Williams.

JOHN BUNYAN AND THE GIPSIES.

To the Editor of the Journal of Science.

Sir,—With reference to what appeared in your issue for January I beg to say that I sent the two pamphlets on John Bunyan and the Gipsies to the "Journal of Science" for the reason that I believed it specially came within its sphere as that of a scientific journal. The Gipsy question, in its essential meaning, is, I think, one of pure Science, and, as I wrote in 1865, "furnishes, among other things, a system of Science not too abstract in its nature, and having for its subject-matter the strongest of human feelings and sympathies." My grounds, among others, for saying so are the following:—

1st. What is it that constitutes a Gipsy? and what must he do to "cease to be a Gipsy," and become more a native of the country than he is already?

2nd. Do habits, character, creed, or any other thing change this race or family into another, so that there is nothing connected with the blood to distinguish it, in fact or feeling, from the other inhabitants of England?

3rd. Does this race, in consequence of the prejudice against it, maintain an incognito against "Jews and Gentiles," and frequently against part of "the blood" itself?

4th. Does this blood, never having been acknowledged, and therefore existing in an outcast condition, transmit to its descendants a "sense of tribe and a soul of nationality," so that they maintain a feeling of being members of a race or tribe that is universal, with words and signs or a sympathy that is peculiar to all such?

5th. What effect has the mixture of this blood on that of the ordinary native, when the marriage is with an incognito Gipsy, or one known to the world as such?

6th. Does not the sentiment of being "a Gipsy" consist in the connecting Gipsy link as to blood, and the children being brought up from infancy to know that they are "Gipsies" or "members of the tribe," and having the feeling strengthened and confirmed by associations with relations and friends who hold themselves to be the same, so that we can find the Gipsy sentiment in various positions in life, and sometimes closely connected with families of the ordinary natives of the country?

These are reasons which I think bring this question before some of the scientific journals of England, which should be the first to take it up on the grounds of fact and reason, apart from feelings of any kind. By them the Gipsy question should be thoroughly investigated and settled, and the Gipsy element in society—from the tent upwards—respected according to the merits of each member of it; so that no prejudice should exist against it as part of the complex population of the British Isles, embracing many thousands in various positions in life. In this way I think that, merely as a question of the "Science of race," it constitutes a legitimate subject of discussion for Journals of Science of many kinds.—I am, &c.,

JAMES SIMSON.

New York, January 27th, 1883.

[Such questions as Mr. Simson raises in the above letter are undoubtedly legitimate subjects for scientific consideration, and there cannot be any objection to their discussion in our pages. But the questions whether John Nokes or Thomas Styles belonged to some particular tribe seem to us of a totally different order.—ED. J. S.]

ZOOPHILISM EXTRAORDINARY.

To the Editor of the Journal of Science.

Sir,—In these days, when to poison a mouse in the interests of Science is a serious offence, it is interesting to find that cock-fighting is experiencing a revival. In Birmingham—which according to a modern statesman is "civilising England," and which recently forbad one of the professors at the Mason College to apply for a license to perform physiological experiments—it is, according to a local paper, "a common thing, in certain beer-houses in that town, to promote the exhibition of dog-fights of a most brutalising description. Only the other night upwards of forty persons assembled in the garret of a public-house, where a pit was constructed of circular boards, fixed with hooks, so as to be capable of dexterous removal in case of a police raid. In this arena two fierce bulldogs, with a stake of £50 depending upon the result, fought with mad fury for forty-seven minutes to an accompaniment of applause and wild yells of delight. A more sickening spectacle it would be difficult to conceive. One of the animals was torn literally to pieces and fell dead upon the floor, and the other was carried away in a terribly mangled condition." Have the "Bestiarians" no word in protest, or is the liberty to tear each other to pieces one of the "equal rights" which the bulldog is to share with the human "rough"?—I am, &c.,

Graduate.

SPACE OF *n* DIMENSIONS, AND THE "UNSEEN UNIVERSE."

To the Editor of the Journal of Science.

Sir,—The conception of space of more than three dimensions, the possible existence of which seems looming upon the mind of some of our most eminent mathematicians and physicists, such as Zöllner, Clifford, and, among the living, Dr. Spottiswoode, may perhaps throw a light upon the existence of a whole series of Unseen Universes, co-existent and mutually inter-penetrating. We live and act in tri-dimensional space. At death we pass into 4-dimensional space, still retaining our power of seeing into, and under certain conditions of interfering in, tri-dimensional space, but incapable of seeing into or conceiving the existence of 5-dimensional space. As our nature becomes more highly developed we pass successively into 5-, 6-, &c., dimensional space, our perceptions and our powers constantly increasing as we approach, without ever reaching a universe of space of ∞ dimensions. This universe is inhabited by One Being only, who is, in virtue of that sole fact, omnipresent, omniscient, and omnipotent. I am not prepared to develop, much less to demonstrate, this hypothesis, but beg merely to put it forward for the consideration of your readers—I am, &c.,

V.

CARLYLE AND THE DARWINS.

To the Editor of the Journal of Science.

Sir,—A certain Mr. Henry G. Atkinson writes—"Carlyle says that the three Darwins—grandfather, father, and Charles—were atheists; and as he knew them all, his statement may be taken as thoroughly reliable." You will rate Carlyle's testimony in this matter at its exact value if you reflect that he was *six years old* when Erasmus Darwin, the grandfather, died, and that we have no proof that the two ever came within a hundred miles of each other.—I am, &c.,

C. F.

ARTIFICIAL LIGHT IN THE PAST.

To the Editor of the Journal of Science.

Sir,—In proof of the small use of artificial light in former times, referred to in your last number, I beg to inform you that country people in the North of England, even down to the middle of the last century, had no candlesticks but home-made ones, moulded of clay. Such were duly made every autumn, and as duly thrown away in the beginning of February. A very old lady whom I met with when a child told me that, in her young days, boys used to go about on the 2nd of February singing—

"It's Candlemas Day,
Throw your candlesticks away."

Mottram St. Andrews.

NOTES.

A Public Meeting was held on the night of January 31st in the Young Men's Christian Association Hall, Manchester, under the auspices of the International Association for the Suppression of Vivisection, to protest against physiological experimentation. A letter was read from Mr. Jacob Bright, M.P., stating that he had never been persuaded that the results of vivisection at all compensated for the suffering inflicted upon animals from its practice. There was a large attendance, and it was made manifest from the beginning that the promoters of the meeting were in a hopeless minority. Prof. Gamgee, of Owens College, led the opposition so far as speaking was concerned, meeting with a most enthusiastic reception. All the three resolutions moved by the Anti-Vivisectors were rejected, amid great cheering, with majorities of at least twenty to one. The proceedings closed with a round of cheers for Prof. Gamgee. We have never "been persuaded" that Mr. Jacob Bright is an authority upon methods of scientific research. But there prevails a superstition that an M.P. must understand all questions and all subjects.

Mr. C. Lloyd Morgan has published in "Nature" an ill-advised account of certain experiments upon scorpions.

Dr. W. A. Hammond, of New York, contends that the "seat of instinct" is the medulla oblongata. He bases his argument upon the power of acephalic monsters to suck, provided the medulla is present. (But what proves "instinct" to be a unitary faculty, having a seat?)

Mr. J. A. Newlands, in a communication to the "Chemical News," claims for himself the prior discovery and announcement of the "periodic law," the merit of which has been ascribed to MM. Mendelejeff and Lothar Meyer.

A medal has been presented to M. Dumas in commemoration of the fiftieth anniversary of his election as a member of the Academy of Sciences.

M. A. Gaudry ("Comptes Rendus") considers that the examination of primary fossils leads us to admit passages from species to species, from genera to genera, and from families to families.

Silpha reticulata, *S. atrata*, and *Phosphuga opaca*, all naturally carrion devourers, have taken to consume the sugar-beet, both in their mature condition and when larvæ.

According to Mr. H. Pollard, the Secretary of the Leeds Naturalist Club, two house martins were seen near Barnsley on October 23rd, and a young one at the same place about a week later.

Mr. A. T. Urquhart reports that in New Zealand earthworms ascend trees in the night or in damp mornings. The English earthworm is a very poor climber.

According to M. Gustav Cellerier ("Astronomische Nachrichter") the nucleus of the comet 1881 behaved optically like a gas. Its power of refraction at a distance of 102,000 kilometres from the nucleus = 0·0000093. Its spectrum has most resemblance to that of a hydrocarbon, especially to olefiant gas. Should such a gas become mixed with our atmosphere the consequence would doubtless be an explosion.

M. Guimaraes ("Comptes Rendus") shows that when coffee is ingested in moderate doses, in the course of a few days the activity of nutrition becomes greater, coincident with a marked augmentation of the pressure of the blood, acceleration of the movement of the heart, and of respiration, with a slight increase of rectal temperature and of the excitability of the nervous centres.

According to M. A. Robin ("Comptes Rendus") the fœtal envelopes of the Phyllostomidæ approach those of the Rodents, from which they differ merely by the absence of a terminal sinus, whilst those of the other *Cheiroptera* are nearer to the Primates.

The "Saturday Review" asks whether "literary study does not now in the lower ranks promote that vice of inobservance which it certainly promoted in the higher ranks a century or two ago?"

The French Academy of Sciences have lately proceeded to the election of a Foreign Associate, *vice* Prof. Wœhler, deceased. Prof. Bunsen obtained 30 votes; Van Beneden, 7; Nordenskiöld, 4; Prof. Adams, 1; and Sir Jos. Hooker, 1. The fact that Prof. Van Beneden stood second on the poll shows what influence the Old Natural History still retains among French official *savants*.

Dr. F. L. Oswald ("Popular Science Monthly"), in an able article on the "Curiosities of Superstition," hints that the dogma of metempsychosis is possibly nothing but a dimly expressed anticipation of the Evolution theory.

M. G. Colin, in a memoir presented to the Academy of Sciences, establishes that microbia are wanting in no part of the respiratory and digestive organs. Under normal conditions they do not impart any virulent quality to the fluids which they inhabit.

M. G. Dupetit ("Comptes Rendus") shows that the edible mushrooms, such as *Boletus edulis* and *Agaricus campestris*, contain in their raw state a juice which proves fatal if injected below the skin of small animals. This poison is destroyed by a temperature of 212° F., and is probably one of the soluble ferments.

The Society for the Advancement of Medicine by Research is said to have "assumed a position of the utmost influence," to include in its ranks "every British biologist of note, lay as well as medical," and to be "receiving very liberal support, moral as well as pecuniary." It is singular that so little should be heard of a Society which has undertaken so important a work, and which is in so prosperous a condition.

M. Planchud ("Comptes Rendus") shows that certain Algæ have a power of reducing sulphates, which is not possessed by lifeless organic matter. He considers that the deposits of metallic sulphides and of free sulphur probably owe their origin to similar microbia.

MM. Gayon and Dupetit, at the same meeting of the Academy of Sciences, gave an account of a class of microbia which reduce alkaline nitrates present in the soil to nitrites.

Dr. C. C. Abbott considers that prior to the advent of the so-called Red Indians the eastern states of North America were inhabited by a people much resembling the Esquimaux.

Ch. A. Vogler states that the proportion of oxygen in the atmosphere fluctuates in accordance with the barometric pressure, the maximum in each being coincident.

M. Barille ("Recueil de Medecine Militaire"), in examining the blood of a horse which had died of rabies, found in the blood a prodigious number of bacteria. The white globules were abnormally numerous, and there were likewise oval corpuscles not present in normal blood, and having all the characters of a *Micrococcus*.

In various quarters we meet with notices of singular cures of diseases, said to be effected by "the prayer of faith," at an establishment in the north of London known as "Bethshan." As medical men take no part in the process we should like to know who diagnoses the various diseases? Hysteria is known to simulate paralysis, lameness, &c.

We learn with no small pleasure that the new American journal, "Science," will admit no advertisements "to which any reasonable objection can be made by scientific men," the

Editors having power of rejection. Hence we presume announcements of proprietary medicines and quackery in general will be excluded. We regret that all scientific organs in England do not adopt so highminded a policy.

We learn that Prof. Owen is in a very critical state of health.

The memorial to the late Prof. Sir C. Wyville Thomson has taken the form of a bust, to be set up in the University Hall of Edinburgh, and a painted window in St. Michael's church, Linlithgow.

The "Medical Press and Circular" predicts that we shall doubtless have murder by electricity before long, followed up by a verdict of "Death by the visitation of God."

Dr. Xaver Landerer, of Athens, maintains that the narcotic honey of Armenia, the effects of which were known as far back as the days of Xenophon, is obtained from the poppies cultivated in that country for the production of opium.

We read in "Light" for January 27th that a Dr. Planat suspends horizontally from the centre of an inverted bell-glass, by a thread of unspun silk, a piece of thin brass wire with its ends beaten out to foil. "The neuric force passing from the pointed fingers through the bell-glass, directed to either end of the wire and moved laterally, puts it in motion."

Unless our memory deceives us similar phenomena were occasionally reported in the earlier part of the present century, but could not be verified on critical examination. It is further stated in "Light" "that the late Mr. Wallington, a potent mesmeriser, assured me that a new knife, worn in his pocket for a short time, acquired the property of attracting needles."

Iron tools, &c., new and old, are so often found to be magnetic that the fact recorded is of no value unless both the knife and the needles had been previously examined and found to be non-magnetic.

"Science" has lost an enemy in the person of the deceased musician R. Wagner. He was committed to the "Anti-Vivisection" movement, and his admirers—blindly following a blind leader—helped to form the "public opinion" which some would have us respect. Perhaps had Wagner lived longer we should have had anti-vivisection operas as a companion-folly to the Edinburgh anti-vivisectionist prayer-meetings.

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By CONSTANCE C. W. NADEN.

> "If I had time to attend to such matters I would send the Pope and the Reformers to school."—PARACELSUS.

PERHAPS I ought to apologise for occupying the time of Science students with an account of one generally described as a disreputable quack. Yet I take heart of grace on reflecting that this seeming charlatan was a great power for good and evil in his own time, and has bequeathed to us certain practical benefits, a few striking ideas, and the impression of a very original and vivid personality.

To study profitably the problems involved in the life and labours of Paracelsus we should recall the tendencies, with regard to science and speculation, of the age in which he lived. He was born in 1493, the year after the discovery of the New World,—nearly fifty years after the invention of printing,—at the noon of the Renaissance and the dawn of the Reformation. The period of his life was a time of flux, of rapid growth, fervid and bright with the agitation of new and old ideas. In spite of the enthusiasm with which the Humanists had exalted Plato, the authority of Aristotle remained supreme in physical research; and since more accurate versions of his works had appeared, the verbose argumentations of the Schools were beginning to be discredited, and something of the spirit, as well as of the mere letter, of his system was being infused into the new generation of students. But Science was still in its infancy. Astronomy awaited the publication, in 1541, of the Copernican "De Revolutionibus." Chemistry was in process of budding off from its parent Alchemy, aided by Basil Valentine, Agricola, and Paracelsus himself. Anatomy was in an inchoate condition, the human body not having been systematically depicted and described before Vesalius, in 1541. Botany was not much further developed, most of the information given in text-books being taken from Greek and Latin authors, until the Commentaries of Fuchs were published in 1542. Medicine had not advanced since Hippocrates and Galen, who still held sovereign sway in the Universities.

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* Read at a meeting of the Mason College Union, Birmingham, February 16th, 1883.

The province of Science was not yet distinctly marked off from that of Poetry, and the mysterious and miraculous found ready credence, whether for its own intrinsic fascination or because it had received the sanction of some venerated name. Yet a true spirit of inductive research was beginning to make itself felt, though, like a pilgrim doing penance on his way to a sacred shrine, it seemed to "take three steps in advance, and one reluctantly backward." New experiments were liable to be discredited by ancient authority, and there were many who would rather doubt their own eyesight than the dictum of Aristotle,—yet these new experiments were repeated and varied again and again, till eyes could no longer refuse to see, nor ears to hear. But if the Old Learning was obstinate, the New was ofttimes presumptuous; if the Old was deaf and blind, the New was dazzled by a play of prismatic colours and confused by a medley of discordant notes. The two opposing tendencies of the time are well typified by a scene in the first and one in the second part of "Faust." In the first, Mephistopheles, disguised as a professor, is ironically commending to a bewildered little freshman the study of Theology. And what he says of Theology might well, in the days of Paracelsus, have been said of all sciences as taught in the Universities.

Mephistopheles.—"You'll always find it best to hear but one;
Swear by your master's words alone.
But stick to words, at any rate,
And enter by this certain gate
Into the temple of the True."

Freshman.— "But with the words must be ideas too."

Mephistopheles.—" Quite right! but spare your too uneasy virtue,
For when ideas all desert you
A lucky word comes in and helps you through.
With words right well we wage our quarrels,
Words fashion codes of thought and morals,
Faith built of words can ne'er be brittle,
Since from a word you can't take jot or tittle."

But later on, in the second part, Mephistopheles again meets the student, who is now a Baccalaureus, and accosts his quondam preceptor with magnificent insolence. In the course of the dialogue he says—

" I practise Youth's pre-eminent vocation,—
Before me was no world,—'t is my creation:*
'T was I who raised the sun from out the sea;
The moon began her changeful course with me;
Day decked herself in dazzling robes to meet me;
Earth budded forth with leaves and flowers to greet me;
I gave the signal on that primal night,
When all the host of heaven burst forth in light.
Who but myself saves man from the dominion
Of dogmas cramping, crushing, Philistinian?
So, free and gay, my spirit's voice I heed,
And follow where the inner light may lead,
Still hasting onward with a gladsome mind,
The Bright before me, and the Dark behind."

These latter lines may stand very fairly for the self-painted portrait of Paracelsus, or, to give him his full title, of Philippus Aureolus Theophrastus Bombastes von Hohenheim. The name by which he is usually known seems to be a bad translation of his patronymic. His father, a physician and alchemist, living at Einsiedeln, not far from Zurich, doubtless initiated him into the elements of the chemistry and medicine of those days; and although little can be ascertained respecting his early history, it is probable that he studied at Basel in his sixteenth year, took a regular degree,—though in what University does not appear,—and served for some time as an army surgeon in Italy and the Netherlands. However this may be, it is certain that he soon began to wander far and wide in quest of knowledge. He visited the Universities of France, Germany, and Italy; but his independent spirit revolted against the slavish veneration paid to the classics of his profession, and rushed to the other extreme of disregarding them altogether. "Reading," he said, "never made a physician. Countries are the leaves of Nature's code of laws; patients his only books." He even states that at one time he did not open a book for ten years. Instead, therefore, of pursuing a regular course of study, he led the life of a vagrant scholar, roaming through Prussia, Poland, Transylvania, Bohemia, Sweden, Spain, Portugal, and even extending his travels as far as Constantinople and Tartary, in search, it is said, of the tincture of Hermes Trismegistus, better known as the Elixir of Life or Universal Medicine. He sought new and strange information in the most obscure quarters, conversing not only with learned men, but with old women, peasants, and conjurors, picking up stray fragments of fact and fable, and welding the whole into a system by that innate originative power which he believed himself to possess in an exceptional degree. He learnt the remedies by which the beldames cured their aches and pains; listened to the wondrous tales of magicians, endeavouring to extract their hidden truth; descended mines and examined the ores; and experimented with various chemicals upon human patients, and—*pace* our Anti-Vivisectionists—probably upon animals. Besides much dross, he managed to gather some very pure gold. He was the first who introduced mercury into the pharmacopœia, or at least the first who proved its efficacy on any extensive scale. The remarkable cures which he accomplished gave rise to a popular belief, apparently countenanced by himself, that he was in possession of a medicine which materially prolonged the normal life of man, though the power of conferring actual immortality was not attributed to the Elixir Vitæ till a later period. His correspondence with Erasmus shows the estimation in which his talents were held by that distinguished scholar, and in 1526 his fame won him a recommendation from the learned Oecolampadius to the chair of Physic and Surgery at Basel. But for this post he was unfitted by temperament and education. His disposition was haughty and impatient, and his disdain of views then regarded as established rested for the most part not on sound inductions, but on the inspirations of an enthusiastic genius which could not be expounded in any lucid form. The commencement of his course of lectures is characteristic of the man. Setting fire to some sulphur in a brazen chafing-dish, he threw into the flames the treatises of Galen and Avicenna, exclaiming "*Sic vos ardebitis in gehennâ.*" He further went on to state that all universities were less gifted than the mere hairs of his own head, and that none of all the ancients was worthy to fasten his shoe-latchets. "You shall follow me," he cried,—"you, Avicenna, Galen, Rhasis; you gentlemen of Paris, Cologne, Vienna, and whomsoever the Rhine and Danube nourish,—you who inhabit the isles of the sea,—you likewise Dalmatians, Athenians, thou Arab, thou Greek, thou Jew,—all shall follow me, and the monarchy shall be mine." Even in an age which allowed far greater exaltation of self and depreciation of others than would now be considered permissible, this rhodomontade was sufficiently remarkable to confer a new meaning upon one of his names—*Bombast.* In opposition to the usual practice, his lectures were delivered in German (possibly because he was a poor Latin scholar), and were at first largely attended by all classes. But if his Latin would have been darkness that might be felt, his German was, to its auditors at least, little better than darkness visible. Hitherto he had confined his intemperance to language, and had lived chiefly on bread and water; but about this time he fell from ascetic purity to the grossest besottedness, and it is even said that his lectures owed all their fire and force to deep potations, and that he never came sober to the bedside of a patient. These habits naturally tended to increase the normal obscurity of his language and to repel his hearers, who fell off one by one—some, perhaps, having seized the cardinal points of his system, which, when clothed in clearer words, might pass as original; some, thinking that they had now spied out the nakedness of this intellectual Canaan; and the greater number, doubtless, from sheer weariness or disgust. At last matters were brought to a crisis by a quarrel between the professor and a canon of the church named Cornelius Lichtenfels, who had promised, in the agonies of gout, to pay a thousand florins for a cure. The cure was effected, but the florins withheld. Paracelsus brought an action at law for the recovery of his fee, but the case was decided against him. He flew into a violent rage, and applied such opprobrious epithets to his ungrateful patient, and to the magistrate who had pronounced the adverse decision, that the town council took the matter up, and dismissed the professor from his chair. He now resumed his errant career, sinking deeper and deeper into debauchery, now saving, now destroying life, by the administration of his potent medicaments. After wandering about in Alsatia, North Germany, Switzerland, and Austria, he was at length seized with a fatal illness in a tavern at Salzburg, and died in the Hospital of St. Sebastian, September 24th, 1541.

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* A pretentious claim, virtually identical with that of Lord Bacon in his Introduction to the " Novum Organon ":—" *Ut opis mentis universum de integro resumatur* "—a claim acquiesced in by the common opinion of contemporary physicists who believe in a total breach of continuity between ancient and mediæval traditions and existing science. (*See* Preface to STALLO's Concepts and Theories of Modern Physics.)

Such was the outer life of this extraordinary man, whose contributions to the theory and practice of medicine, and to other departments of thought and knowledge, I must now briefly notice. As already remarked, the chief practical service of Paracelsus was his application of chemical preparations to medicinal purposes, in lieu of the vegetable decoctions which had previously been in use. Though he repeatedly gives directions for the transmutation of the base into the noble metals, yet in intervals of sobriety or sincerity he recognises the fallacy of this pseudo-science, and expressly states that "the province of alchemy is not to make gold, but to prepare medicines." It is certain that he gave a great impetus to the study of chemistry, and that after his time it became a necessary branch of medical education, and was taught in schools and colleges.* The new force thus brought into play counts for a great deal more than the actual remedies which he has bequeathed to us, though these are of great importance. Among them are preparations of mercury, lead, antimony, sulphur, blue vitriol, iron, and arsenic. His so-called "laudanum" was not opium, but a compound of mercury or antimony with other drugs.

The physiological and pathological theories of Paracelsus were of course crude, and yet showed a certain advance upon his predecessors. All bodies, he taught, including the human frame, consist of three elements—salt, sulphur, and mercury. The just equilibrium of these is health; the excess or defect of any, disease. This seems at first sight something like nonsense; but let us examine a little further. The names of these three elements were not specific, but generic; that is, there were many sulphurs, many salts, many mercuries. Salt represented the principle of fixity, sulphur that of combustibility, and mercury that of volatility. When a substance burns, vapour is given off, a flame is seen, and ashes remain. Nothing could be more natural than to conclude that the substance was made up of three parts,—vapour, flame, and ash,—or, a volatile, a combustible, and a fixed ingredient. Excess of the first in the human body caused insanity; of the second, fever; of the third, stiffness of the joints, and diseases accompanied by the deposition of calculi, which Paracelsus generalised under the name of tartareous disorders, from a supposed analogy with the precipitation of tartar during vinous fermentation. The vegetable and mineral worlds were subject to similar maladies. Gold was the only metal in which the elements were mixed in true proportion. All others were more or less out of health, and it was theoretically possible that iron and copper, lead and tin, might be "cured" by the alchemist and restored to their pristine Paradisaical purity. Spite of the errors into which he was led, some praise is due to Paracelsus for his apprehension of the fact that vital processes are identical with those which take place in the inanimate world. "*Ignis vita, lignum corpus*"—the body is the wood, the life is the fire—was one of his sayings, to which modern Physiology has given a new import. Much mysticism enfolded this embryonic science. "Digestion," said in substance our professor, "is presided over by a spiritual ruler, who lives in the stomach, and is called the Archæus. If he is ill or out of temper, dyspepsia ensues, so that it is the business of a wise physician to keep on good terms with this gastric potentate, and to study his tastes and necessities. This will in part be accomplished by a diligent study of the stars. Man has an astral as well as a terrestrial body, and all his motions are typified and prefigured in the skies. Human destiny is not *influenced* by celestial phenomena, but runs parallel with them, in a kind of pre-established harmony." According to this theory, indeed, all Nature is literally alive. Even minerals have a feeble animation, for they grow, feed, and excrete. This may have been simply a metaphorical way of describing chemical union and decomposition, which in reality form an essential factor in that sum of forces which we have named Life. Fire, Air, Earth, and Water are deposed from their Aristotelean position as elements, and regarded as conditions of matter, under the names of the Hot, the Cold, the Dry, and the Moist,—the cosmic vitality peculiar to each being allegorised by the invention of appropriate genii, called Salamanders, Sylphs, Gnomes, and Undines. That Paracelsus seriously considered these beings as other than poetic fictions, typifying the universality of life, is scarcely probable, though he doubtless often amused his cynical and world-worn spirit by playing on the credulity of both learned and vulgar. He may, however, have believed to some extent in his doctrine of "signatures." The form of a natural object was supposed to be an index to its properties. For instance, the venation of the leaves of the lesser celandine was compared to the venation of the liver, and this fancied resemblance was taken as a sign that the celandine must be good for jaundice. The bright petals of the little *Euphrasia* seem dotted with tiny violet eyes; therefore the plant was a specific for ophthalmia, on the principle of "*Similia similibus curantur.*" It is not necessary to point out the fallacy of speculations such as these, but it may be well to show *why* they are fallacious. *A priori* absurdity has nothing to do with it. There is nothing especially ridiculous in the proposition that things which have the same internal properties will have a similar external appearance. Nor is it more improbable that a spiritual ruler resides in the stomach than that such a monarch is domiciled in the brain. No; these theories are inadmissible, because they do not fulfil the conditions of a sound scientific hypothesis, which should adequately generalise a whole class of phenomena,—should be able to prove a sound homological relationship with some already demonstrated law or group of facts,—and, finally, should be confirmed by every fresh experiment, accounting for facts discovered subsequently to its formulation, and enabling us to predict the path in which future discoveries are likely to be made. It should explain the unknown by the known, and thus light the way to future knowledge. Here Paracelsus failed; and here, for lack of material, he must have failed, even though his genius had really equalled his self-confidence. Yet he did good, rather than harm, by following that inner light which so often led astray. The scope of his mind may best be estimated by a study of that sublime imagination of Macrocosmos and Microcosmos to which all his leading ideas may be referred. "Man," he might have said, "is the Universe in miniature. The Universe is an enlarged edition of man. The only true science is therefore the science of the human mind and body, and he who has literally obeyed the precept 'Know Thyself' has comprehended the sum of Knowledge. From the rhythmic motion of his own vital organs he can deduce the orbits of the stars; by the stars, again, he can interpret his own fate. From the ill health of his body he may learn the malady which has degraded pure gold to a baser metal, and may even find a cure for both diseases. The flowers of the field are his helpful kindred. 'Herbs gladly heal our flesh, because that they Find their acquaintance there.' * The spirit of the greater world responds to the spirit of the lesser world, and reveals its mysteries with or without the aid of sense. Not every man can hold this communion, which requires a certain corporeal and spiritual purity; but to him who has attained it, the disputations of the schools and the lore of antiquity are alike worthless. He may, indeed, study

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* Alchemy must be regarded not as a mere medley of dreams and fables, but as an early stage in the history of Chemistry, which was no creation either of Boyle or of Lavoisier.

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* The anachronism of a quotation from George Herbert in an imaginary speech of Paracelsus must be pardoned! It is, of course, the sober truth that both vegetable and mineral medicines "find their acquaintance" in the bodies which they heal.

Nature; but the study of Nature will only be the study of himself."

Such are the outlines of a system based on that idea of correlation between vital and physical forces which fascinated the philosophic intellect long before it could be substantiated on scientific grounds. We find its foreshadowing in the Idealism of Plato. The World, according to him, is a great living Being, fashioned by God after the model of the eternal Universe of Ideas, and endowed with a soul. In this soul all other beings participate, each in his own degree, the fullest measure being granted to man. He, indeed, may become so noble and so pure as to catch glimpses of those immutable Ideas to which his life owes its origin. In these Ideas is contained the explanation and inmost essence of God, Man, and the World, and to find them is to find the only true wisdom. It will be seen that we have here reached the central fire of all mysticism, whether of Greece, India, or modern Christendom; but perhaps the fire may kindle other lamps than that which glows on the altar of the Mystic. We may find a positive basis of scientific fact for what seems at first sight a mere poetic imagination. The details are mere metaphors, but the essential content may be a germ of pure truth.

That in studying external Nature we are really studying modifications of our own consciousness scarcely requires demonstration. Colours and sounds are manufactured by eye and ear, or rather by those cerebral centres with which eye and ear are in nervous continuity; and the ideas of colour and sound cannot reside elsewhere than in the brain which gave birth to the corresponding sensations. But eye, ear, and brain are not separate from the so-called "external" world. They are constantly exchanging with their environment matter for matter, and force for force. They submit to the same physical laws which reign over inanimate Nature. Gravitation, heat, light, electricity, are all at work; the laws of optics or acoustics apply just as much to the eye as to the spectacles, to the ear as to the telephone. Yet more—the essential phenomena of human nutrition and development are repeated in all other animals, and even in plants. From the lowest much may be learnt which holds good of the highest. Take the *Amœba*. Is it not an *exact* homologue of the white blood-corpuscle in man? Both are contractile, irritable, automatic. Both can feed, breathe, and reproduce their kind. Indeed the relation of the blood-corpuscle, or of any other living cell, to man, well typifies man's relation to the Macrocosm. His body is the world where myriads of tiny individuals are born, live, move about, perform their various functions, and die. May he not truly call himself a Microcosm? Even the doctrine of Reminiscence or Intuition must find a place, though a humbler one than that assigned it by Plato and Paracelsus. It is what we name Instinct or Hereditary Aptitude, and of course plays a great part in all theories of Evolution. Every one will now-a-days admit that the mind is not a mere sheet of white paper, on which the external world writes. It is rather a mould, into which the external world is poured. The young of all animals—of man among the rest—come into existence with certain organic predispositions, and can perform certain actions without being taught, and others with very little teaching. The mind grows in that direction in which the organism is bent. Even abstract ideas, though not actually innate, can be implanted in some constitutions far more readily than in others; they come more naturally, as we say, to the "supreme Caucasian mind" than to the African or Red Indian. Faculties are innate, though ideas are not; and the seemingly instinctive grasp of truth, which is the privilege of a few, may not unfitly be allegorised as a direct communion between the human soul and the Anima Mundi.

I have now completed my sketch of the merits and demerits of Paracelsus, who gave a temporary incarnation to thoughts which had descended from antiquity, and which have since roamed about under various shapes and titles till they have at last transmigrated into the conceptions of modern science. The special form with which he endued them has now only an historical intereest; yet his labour was not lost. Facts must be accumulated; but the human spirit cannot live on facts alone. If there are not enough to constitute the basis of a scientific theory, it demands, and will have, an unscientific one. And those who supply its needs help to maintain its vitality. But directly the scientific *rationale* becomes possible, it also becomes imperative: and he who still seeks to preserve the old unscientific dogma is a foe instead of a friend,—a poisoner instead of an almoner; for bread he gives a stone,—for an egg he offers a scorpion.

II. THE BIRTH AND EVOLUTION OF THE SOLAR SYSTEM.

TRANSLATED FROM PAGES 113 TO 132 OF "GEDANKEN"
(1857, Philadelphia, published by Thomas).

By O. REICHENBACH.

(Concluded from page 152.)

THE relations of the exterior system are inverse and corresponding at the same time. It separates by staying behind. It is the real central mass, the perihelion, Jupiter which projects. The largest concentration, from which the others develop themselves centrifugally, falls beyond the point of gravitation, which is at 7808 r solar distance.

It so corresponds with regard to mass planet A to the Earth, Neptune to Venus; in reference to distance from point of gravitation it is the reverse. It corresponds in such twofold manner, but again reversed—Uranus, the projection of A, to Mercury; planet B, the projection of Neptune, to Mars. We so have, as distances of those planets from their point of gravitation,—

A ... ... $7808\,r \times 1{\cdot}107 \times 1{\cdot}05 = 9050\,r.$

Neptune—

$$\frac{7808\,r}{1{\cdot}212} = 6447\,r.$$

Uranus—

$$\frac{7808\,r \times 1{\cdot}05}{1{\cdot}72 \times 1{\cdot}107} = 4012\,r.$$

B ... ... $7808\,r \times 1{\cdot}72 \times 1{\cdot}22 = 16360.$

We know how the mass is distributed amongst the three systems, and amongst the two central parts; it remains to find its distribution in the secondary systems.

The mass of A is of that of Jupiter—

$$\frac{1}{8{\cdot}8 \times \left(\frac{1{\cdot}22}{1{\cdot}025}\right)^2} = \frac{1}{12{,}911} \text{ of the solar mass.}$$

Neptune is—

$$\frac{1}{12{,}911\times\left(\frac{1{\cdot}22}{1{\cdot}1\times1{\cdot}05}\right)^2}=\frac{1}{14{,}202}.$$

Uranus projected by A—

$$\frac{1}{12{,}911\times(1{\cdot}22\times1{\cdot}1)^2\times1{\cdot}05^2}=\frac{1}{24{,}918}.$$

B projected by Neptune—

$$\frac{1}{14{,}202\times\left(\frac{1{\cdot}22\times1{\cdot}107}{1{\cdot}05}\right)^2}=\frac{1}{22{,}729}.$$

Venus is of the mass of Saturn—

$\frac{1}{77\times1{\cdot}21^2\times1{\cdot}025^2}$, or $\frac{1}{413{,}800}$ of the solar mass.

The Earth—

$\frac{1\times\left(\frac{1{\cdot}22}{1{\cdot}107\times1{\cdot}025}\right)^2}{415{,}800}=\frac{1}{359{,}511}$ of the solar mass without the moon.

Mars projected by Venus—

$$\frac{1\times1{\cdot}22^2\times1{\cdot}05^2}{415{,}800\times8{\cdot}8}=\frac{1}{2{,}345{,}112}.$$

Mercury projected by the Earth—

$$\frac{1}{359{,}511\times8{\cdot}8\times1{\cdot}22^2\times1{\cdot}025^2}=\frac{1}{4{,}943{,}275}.$$

Astronomy gives these masses—

Mercury	$\frac{1}{4{,}865{,}751}$.	Venus	$\frac{1}{401{,}839}$.
Earth	$\frac{1}{359{,}511}$.	Uranus	$\frac{1}{24{,}605}$.
Neptune	$\frac{1}{14{,}446}$.	Earth with Moon	$\frac{1}{355{,}499}$.

The differences with my numbers are insignificant. The only more considerable is with Mars, yet Astronomy does not pretend to give the masses of the moonless planets with precision : I also do not insist that the mass I give for Mars is exact. There is a tertiary perturbation, considerable in proportion to the system—our Moon; planet A may show something similar. The Moon as mass does not belong to the Earth: the quantity of the latter was too great; it threw off the surplus which did not reach its aim—Mars. Mercury, the co-planet of the Earth, thus probably also obtained more mass; 1-14th of the mass of our moon it ought to be.

This disturbance, perceptible with Saturn, is probably connected with the asteroids. The mass of them has thus to be equal to—

$$\frac{8{\cdot}8 \times 1{\cdot}22}{680^3} = \frac{1}{29{,}500{,}000}$$

of that of the Sun.

The mean distance of Flora is 471 r; of Hygiea, 671 r.

$$680\,r - (77{\cdot}3\,r \times 2{\cdot}96) = 456\,r = 397\,r \times \frac{1{\cdot}22}{1{\cdot}05}.$$

The former is in the mean little beyond that region, in which the inner projection might have seized it; the latter still inside 680 r, not far from the original central planetary mass. Both are in that region which appears like empty at the head of the comet between nucleus and envelope. Should not a number of such asteroids, 2·76 times less in mass, exist between 3676 r and 3820 r distance?

The mass of the Moon is 1-87 of that of the Earth; it is 1-31,282,500 of the Sun, if we add the 1-14·87 which the mass of Mercury appeared larger than Enke's calculation made it out; the quantity becomes 1-29,500,000 of the solar mass: others give the mass of the Moon 1-81 of that of the Earth, which at once gives 1-29,500,000 of that of the Sun. The diameter of our Moon is 454 geographical miles; that of the largest of the planetoids is believed not to exceed 145 miles: it would require twenty-eight such bodies, of equal density with our Moon, to make up the latter.

I made the mass of Mars 1-2,345,112 of the Sun. Astronomy gives it 1-2,680,337: if we deduct from the former figure the mass of our Moon, 1-29,500,000, and the plus of Mercury (or possibly of a lunar system), we get about the second figure (but even the mass of the planetoids may be considered a reduction of the mass of Mars).

I return from these problematic tertiary relations to the secondary. We found the density of the central parts to agree with observation; the latter gives the densities:—that of the earth, 1·000; the Sun, 0·252; Mercury, 1·234;

Mars, 0·698; Venus, 0·940; Jupiter, 0·243; Saturn, 0·140; Uranus, 0·178; Neptune, 0·238. It is difficult to account for laws of density; we entertain a general idea, we see if the results correspond, and we are satisfied when we reason logically. Density must depend on the relations of the projecting masses, and on the pressure to which the projected mass is exposed at its ultimate position. In the case of the two central planets the relation was less complicated. The mass of the secondary systems is projected between its central part and the solar influence—here repulsive, there attractive. We seek at first the imaginary density, the point of gravitation; from this we infer the density of the concentrations. The exterior system is projected by the smaller mass between the larger mass and the Sun.

We had the density of the primary point of gravitation equal to that of the Sun, equal 1. Matter projected by Saturn arrives here between a mass 3·347 times greater and the Sun, and thus becomes 3·347 times more dense than 1 (the Sun): but Saturn has an elongation of 1·025; matter arrives consequently with a retardation of 1·025; density so becomes—

$$\frac{3{\cdot}347}{1{\cdot}025^2} = \frac{3{\cdot}347}{1{\cdot}05},$$

$\doteq 3{\cdot}2$ more than that of the Sun. The greater, then, the elongations of the concentrations, so much more they are pressed against the more powerful limiting bodies, so much denser they become; so are more dense than the Sun.

Venus ... $3{\cdot}2 \times 1{\cdot}107 \times 1{\cdot}05$.
Mars ... $\dfrac{3{\cdot}2}{1{\cdot}107 \times 1{\cdot}05}$.
Earth ... $3{\cdot}2 \times 1{\cdot}22$.
Mercury $3{\cdot}2 \times 1{\cdot}22^2$.

Comparing these densities with those of observation, the density of the Earth is 1-1·012 less, or that of the Sun 0·255 of that of the Earth; Jupiter and Saturn agree with observation; Venus and Mercury are slightly less than the figures of observation. A more considerable difference exists with regard to Mars. The exterior system is projected by the larger mass, by the recalling distant attraction of the Sun and the smaller less dense mass of the central aphelion (Saturn). It is the central mass which projects; the density would so be equal to 1, to that of the Sun; but as the projecting mass has an elongation of 1·05 towards the Sun, the propelled mass arrives with a $1{\cdot}05^2 = 1{\cdot}07$ times greater velocity, density becomes 1·107 more than that of the sun. The concentrations are here by their elongations pressed against the re-attracting yet decreasing force of the Sun, and against the central aphelion; their density decreases with elongation.

Point of gravitation 1·107 more dense than the sun.

A ... ... $\frac{1{\cdot}107}{1{\cdot}102 \times 1{\cdot}05}$ of the density of the sun.

Uranus ... ... $\frac{1{\cdot}107}{(1{\cdot}107 \times 1{\cdot}05)^2}$.

Neptune ... ... $\frac{1{\cdot}107}{1{\cdot}22}$. B ... ... $\frac{1{\cdot}107}{1{\cdot}22^2}$.

The densities are therefore—that of the Earth, 1; the Sun, 0·255; Mercury, 1·22; Mars, 0·69; Saturn, 0·141; Neptune, 0·232; Venus, 0·930; Jupiter, 0·243; Uranus, 0·200; A, 0·242; B, 0·187.

Proceeding to the velocities of rotation, I begin again with the inner system. Rotation of the point of gravitation of the central mass was 68·5 times more rapid than that of the Sun. As the mass now proceeds from the aphelion it moves 2·95 times more slowly, but by the elongation it experiences 1·21 more rapidly. The point of gravitation at 176 from the Sun would therefore have a rotation—

$$\frac{68{\cdot}5 \times 1{\cdot}22}{2{\cdot}96} = 28{\cdot}1$$

more rapid than that of the Sun.

The velocity increases inversely as the square of the single elongations increases. We have for—

Venus $\frac{28{\cdot}1}{\sqrt{(1{\cdot}10 \times 1{\cdot}025)}} = 26{\cdot}31$; Earth $\frac{28{\cdot}1}{\sqrt{1{\cdot}22}} = 25{\cdot}38$;

Mars $\frac{28{\cdot}1}{\sqrt{(1{\cdot}10 \times 1{\cdot}025)}} = 24{\cdot}63$; Mercury $\frac{28{\cdot}1}{1{\cdot}22}$

days during one revolution of the Sun.

A difference there is with Mercury, whose day is 26 h. 26 m., whereas observation has adopted 24 h. 5 m.

The separation of the inner system resulted by a more rapid transport; it may be considered as resulting from a shock, the line of planetary development experienced between G and γ in the sense of the whole transportation (designating the central point of gravitation by G, the interior one by γ, the exterior one by g). The largest masses of both systems, the central and the inner one, are between G and γ; thus nothing is altered in the sense of rotation. It is otherwise with the exterior system, separated by remaining behind in revolution, whose outward larger portion moves more slowly than the inner one, the former being projected by the larger Jupiter and re-attracted by the smaller Saturn. The separation resembles a shock still in the sense of translation between G and g, but between smaller masses matter will revolve with a velocity corresponding to its position, but in an opposite sense; A will comparatively stay behind in elongation (and we may ask if the result should not be a double undulatory rotation, an access to rotate forward and a real backward rotation ?)*

We thus have absolute forward rotation of g in the sense of general transport—

$$\frac{68{\cdot}5}{1{\cdot}72\times 1{\cdot}102}=36.$$

$$\text{A, } 36\sqrt{(1{\cdot}102\times 1{\cdot}05)}=39;\ \text{Neptune, } 36\sqrt{(1{\cdot}22)}=40;$$
$$\text{Uranus, } 36\times(1{\cdot}1\times 1{\cdot}05)=41{\cdot}6;\ \text{B, } 36\times 1{\cdot}22=43{\cdot}6$$

revolutions during one revolution of the Sun.

Doubts of the probability of this development may give way before an examination of the excentricities of orbits. They are—

Mercury	0·20561	Jupiter	0·048162	Uranus	0·0466108
Venus...	0·00686	Saturn	0·056150	Neptune	0·0087194
Earth...	0·016729			A... ...	0·0038894
Mars ...	0·093216			B... ...	0·11366

Whoever recollects how these bodies formed in groups will recognise the relation with excentricities, and how the points of gravitation and mean distances of planets are quantities round which they unroll centrifugally and roll up centripetally.

We have for the central poles—Jupiter, 0·04816; Saturn, 0·05615. We have—

$$\frac{0{\cdot}05615}{0{\cdot}04815}=\frac{\left(\frac{1{\cdot}22}{1{\cdot}025}+1{\cdot}107\times 1{\cdot}05\right)}{2}=1{\cdot}167,$$

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* This view requires correction.—Reich.

And—

$$\frac{1{\cdot}167}{2}=\frac{1}{1{\cdot}72}.$$

$1169{\cdot}6\,r-1116{\cdot}6\,r=53\,r$ as elongation of Jupiter.

$$\frac{53\,r}{1116{\cdot}6\,r}=0{\cdot}0479=\text{excentricity of Jupiter.}$$

Saturn, $2047\,r$ as distance, $41\,r$ as elongation, 2·96 as development of aphelion.

$$\frac{41\,r\times 2{\cdot}96}{2047\,r}=0{\cdot}0572=\text{excentricity of Saturn.}$$

We pass on to the interior system:—

$\frac{\text{Earth }0{\cdot}01672}{\text{Venus }0{\cdot}00686}=2{\cdot}447$, and $\frac{2{\cdot}447}{2}=1{\cdot}223$ aphelion direct.

$\frac{\text{Mercury }0{\cdot}20561}{\text{Mars }\ldots\ 0{\cdot}9321}=2{\cdot}205$, and $\frac{2{\cdot}205}{2}=1{\cdot}103$ perihelion indirect.

Adding the excentricities of the corresponding concentrations we have—

Mars ... ... 0·0932
Venus ... ... 0·0068

0·1000

Div. by $2\times1{\cdot}025$ ...)0·048 = excentricity of Jupiter—antipole.

Earth ... ... 0·0167
Mercury ... ... 0·2051

0·2218

Div. by $2{\cdot}172\times1{\cdot}22$)0·0559 = excentricity of Saturn—synpole.

The excentricities of projections derive from their projections:—

For Mars.—Excentricity of Venus $0{\cdot}00686\times8.8\times1{\cdot}22^2=$ $=0{\cdot}0934$, excentricity of Mars.

For Mercury.—Excentricity of Earth $0{\cdot}0168\times8{\cdot}8\times$ $\times(1{\cdot}107\times1{\cdot}025)^2=0{\cdot}200$, excentricity of Mercury.

We have, for the exterior system, distance of A 9050 *r*, and—

$$\frac{77{\cdot}3}{9050\times1{\cdot}72\times1{\cdot}107\times1{\cdot}05}=0{\cdot}00427,\text{ excentricity of A.}$$

Distance of Neptune, 6447 *r*:—

$$\frac{77{\cdot}3}{6447\times(1{\cdot}107\times1{\cdot}22)}=0{\cdot}0087,\text{ excentricity of Neptune.}$$

Uranus, excentricity of A $0{\cdot}00427\times8{\cdot}8\times(1{\cdot}107\times1{\cdot}025)^2=$ $=0{\cdot}0466$, excentricity of Uranus.

B, excentricity of Neptune $0{\cdot}0087\times8{\cdot}8\times1{\cdot}22^2=0{\cdot}1136$, excentricity of B.

$$\frac{\text{Excent. of B... ... }0{\cdot}1136}{\text{Excent. of Uranus. }0{\cdot}0466}=2{\cdot}44,\text{ and }\frac{2{\cdot}44}{2}=1{\cdot}22.$$

$$\frac{\text{Excent. of Neptune }0{\cdot}0087}{\text{Excent. of A... ... }0{\cdot}0042}=2{\cdot}10,\text{ and }\frac{2{\cdot}10}{2}=1{\cdot}05.$$

$$\begin{array}{lr}
\text{Excent. of A... ...} & 0{\cdot}00427\\
\text{Excent. of Uranus.} & 0{\cdot}04661\\
\hline
2\,) & 0{\cdot}05088\\
\hline
 & 0{\cdot}02544\\
\hline
\end{array}$$

$0{\cdot}02544\times1{\cdot}72\times1{\cdot}107=0{\cdot}048$, excent. [of Jupiter.

$$\begin{array}{lr}
\text{Excent. of Neptune} & 0{\cdot}0087\\
\text{Excent. of B... ...} & 0{\cdot}1136\\
\hline
2\times1{\cdot}05\,) & 0{\cdot}058
\end{array}\ =\text{ excentricity of Saturn.}$$

The excentricity of Jupiter now increases, of Saturn decreases, of Venus and Earth decreases, of Mercury and Mars increases, of Uranus and B decreases, of Neptune and A increases.

In the original, and in "Two Planets" I then go on to the other elements, the actual position of the latter planets included; to the lunar systems, where some revision is required; and to the own motion of the solar system, corrected in "Two Planets."

Having, since the publication of the above, shown the connection of planetary excentricities with the proportions of their solid and fluid masses, and the general intimate reciprocity of all solar with all planetary phenomena, the interchange of matter between the bodies of the system cannot be questioned; and I may some day ask your permission, Mr. Editor, to speak about *its manner* in the "Journal of Science."

III. CHARLES DARWIN: HIS BIOGRAPHERS AND HIS TRADUCER.*

THE discussion of these brief but important and appreciative sketches of Charles Darwin, as a geologist, a botanist, a zoologist, a psychologist, and as a man, is rendered the more seasonable by a singular incident. A voice has been raised against the great naturalist from an unexpected quarter. One Henry G. Atkinson has seen fit to write and to publish these words:—"Carlyle says truly, 'A good sort of man is this Darwin, and well-meaning, but with very little intellect.'" (!) Again:—"All agree that his [Darwin's] introducing a Creator to breathe the breath of life into the first form was mere subterfuge. Carlyle says that the three Darwins—grandfather, father, and Charles—were Atheists; and as he knew them all, his statement may be taken as thoroughly reliable."

To adjudicate on the religious orthodoxy or heterodoxy of scientific men is certainly not, under any ordinary circumstances, our duty; but the imputation of Atheism is here mixed up with a charge of dishonesty, and with such an amazingly impertinent attempt to disparage Darwin intellectually, that we feel bound to exhibit the accuser and his witness in their true colours.

We ask, firstly, Did Carlyle really and truly commit himself to the utterances which are here ascribed to him, and especially did he lay claim to a personal knowledge of the three Darwins? If so, he was guilty of a grave departure from the truth. It is known that he was born in 1795, at Ecclefechan, where he spent his childhood. It is equally well known that Erasmus Darwin died in 1802, at Litchfield. There is, as a correspondent tells us, no tittle of evidence that the two ever came within a hundred miles of each other; and there is further no shadow of likelihood that, had they met, the old physician would have expounded his theological views to a peasant child under seven years of age, or that the latter, had he done so, would have attended to or understood the lecture. If Carlyle cannot claim a personal knowledge of the elder Darwin, but judged merely from common report or from published documents, his statement is, as we shall see, *not* "thoroughly reliable," or, in English, trustworthy. It is, however, conjectured by some that the charges brought against the Darwins may be traced to an apocryphal or pseudo-Carlylean letter which appeared in a Scottish provincial journal, and which seems to have been widely reproduced as if genuine. Be this as it may, Mr. Henry G. Atkinson has shown culpable levity and indiscretion in adopting and repeating such assertions without due inquiry into their evidences. Had he examined the works of Erasmus Darwin he would have discovered—*e.g.*, in the "Phytologia," written only three years before the author's death—ample disproof of the charge of Atheism. This book bears as a motto on its title-page the following line from the "Ordo Naturæ" of Linné:—"*Suadent hæc Creatoris leges a simplicibus ad composita.*" On reading through the work Mr. Atkinson would have found not merely a total absence of any denial of the existence of God, either explicit or by inuendo, but he could scarcely have overlooked such passages as the following:—"Great God of Justice! grant that it [sugar] may soon be cultivated only by the hands of freedom, and may thence give happiness to the labourer as well as to the merchant and the consumer" (p. 77). Or—"Surely this must be called a wise provision of the Author of Nature, as by these means innumerable animals enjoy life and pleasure without producing pain to others. There is another source of nutriment provided for young animals which still further evinces the benevolence of the Author of Nature, and that is the milk furnished by the mother to her offspring: by this beautiful contrivance the mother acquires pleasure in parting with a nutritious fluid, and the offspring in receiving it" (p. 82). Or the following:—"Thirdly, there should be no burial-places in churches or in churchyards, where the monuments of departed sinners should shoulder God's altar, pollute His holy places with dead men's bones, and produce by putrid exhalations contagious diseases among those who frequent His worship" (p. 242). Or, lastly:—

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* Charles Darwin. Memorial Notices reprinted from Nature. London: Macmillan and Co.

"We acquire the sublime and interesting idea that all the calcareous mountains of the world are monuments of the past felicity of organised Nature, and consequently of the benevolence of the Deity" (p. 560). Whether these passages, to which many more might easily be added from the other works of Erasmus, do not outweigh the statement of Carlyle, even if not a forgery, we cheerfully leave to the judgment of our readers.

Turn we next to Dr. Robert Darwin, the father of Charles. This gentleman was admittedly for many years the contemporary of Carlyle. It is perfectly possible that they may have met, and even—though we have no evidence to that effect—that some degree of intimacy may have existed between them. But there is no collateral evidence in support of the alleged Atheism of Robert Darwin. The mere word of Thomas Carlyle can count for very little, for though he might not consciously and knowingly promulgate falsehood he was essentially a self-deceiver. Though far from orthodox himself, and at one time regarded by the religious world as an arch-infidel, he had an intense hatred of Atheism and "Materialism," and was apt to suspect their presence where non-existent. In opposition to his alleged testimony, it is a known fact that Robert Darwin was a member of a Unitarian congregation at Shrewsbury. He further, as may be learnt from the little work before us, destined his illustrious son for the Church. With this view Charles was sent to the University of Cambridge, where he graduated as B.A. in 1831, and as M.A. in 1837. Nay, even in 1838, when he was about setting out on his memorable voyage, his father hesitated, fearing lest it might "unsettle him for the Church." We can scarcely imagine an avowed Atheist seeking, during the term of more than seven years, to devote his son to a clerical career. Here also, as in the case of Erasmus, we are forced to conclude that Carlyle's evidence, as given by Mr. H. G. Atkinson, is, if authentic, untrustworthy.

Charles Darwin and Thomas Carlyle were of course contemporaries for upwards of threescore years. Their respective places of abode were, since 1842, not very far apart. The "philosopher of flatulence and acid indigestion," as Carlyle has been happily named, was well acquainted with a brother of Darwin's, and may consequently have met with the great "Reformator" of Natural History. But between two characters of such world-wide difference there could be little sympathy. Hence, without such full proof as would satisfy a court of justice, we must decline to believe that Darwin would make a confidant of Carlyle.

We must protest against the assertion—"All agree that his introducing a Creator to breathe the breath of life into the first form was mere subterfuge." All do not so agree! Few of those who have studied Darwin fairly and faithfully in his works—fewer still of the more fortunate circle who have enjoyed his personal intimacy—will be ready to accuse him of a "subterfuge." A chivalrous devotion to truth, quite independent of its possible bearings upon his theories, his reputation, or his interests, was one of the most strongly marked features of his character. Whether in the latter part of his life he adopted atheistic opinions—as is asserted by Prof. Haeckel, Dr. Aveling, and others both among his admirers and his enemies—is not here the question. But that he wrote the memorable concluding passage of the "Origin of Species" in good faith we shall uphold until we meet with very decisive evidence to the contrary.

The joint verdict of Thomas Carlyle and of Mr. Henry George Atkinson, that Darwin was a man of "very little intellect," is too ridiculous for formal examination, and will be endorsed only by those who cherish the well-known aspiration of Dogberry. To give a new impulse and a new direction to every department of Organic Science, to breathe into research a new spirit, a veritable breath of life, must be recognised as a very different task from writing essays and histories, in however striking or grotesque language.

It is common for the religious world to infer that every atheist, everyone who can be included under the ill-defined classes of "infidels" and "skeptics," must of necessity be Evolutionists and admirers of Darwin. Let them remember that Auguste Comte, and his followers the "Positivists," with perhaps the single exception of the late George Henry Lewes, are decidedly hostile to Evolution. And here we find a most contemptuous estimate of Darwin formed by such heresiarchs as Carlyle and Mr. H. G. Atkinson.

But enough of these worthies: let us turn to a more pleasing task, and examine the judgment pronounced upon our great naturalist by competent authorities—his friends and fellow-workers.

Prof. Huxley, in his "Introductory Notice," appreciative as it is, and breathing a noble affection for the Departed, contains one unfortunate passage to the effect that "One could not converse with Darwin without being reminded of Socrates." Perhaps had Prof. Huxley ever conversed with Socrates he would not have ventured on this comparison. The vast difference between the two was explained in the "Journal of Science" for June last.

We come to the sketch of Darwin's character and life as furnished by Mr. G. J. Romanes. Here we find a full and just tribute paid at once to the wonderful intellect, and, what the writer ranks as "no less great, or even greater," the character of the man. He proclaims it as his first duty "to render some idea, not of what Darwin did, but of what he was." It is impossible for us to reproduce the portrait of Darwin as here drawn with equal truth and beauty. We read that "in him the man of Science and the philosopher were subordinate to the gentleman. His courteous consideration of others, which went far beyond anything that the ordinary usages of society require, was similarly prompted by his mere spontaneous instinct of benevolence. . . . No man ever passed away leaving behind him a greater void of enmity, or a depth of adoring friendship more profound."

All this is true, and we are happy to find it thus distinctly recorded. But wherefore? For in one sense it must be admitted, as Buckle insisted, that what a man *is* is of far less general and permanent importance than what he *does*. Character is soon forgotten; but performances, works, achievements, whether in the inner or the outer sphere, are the property of the world for ever. But the beauty and the grandeur of Darwin's character, and the happiness of his life, are precious as affording the best answer to that new school of Ethicists who pronounce Science hostile to happiness and morality. Such persons will find that, whilst in Darwin incessant intellectual activity crowded out moral evil and superseded the necessity for a "struggle with temptation," he did not "freeze and harden," and his "natural affections" did not "vanish."

Darwin was first sent, in 1825, to the University of Edinburgh, then in the zenith of its reputation as a medical school. Here, it appears, he studied under Prof. Jameson, F.R.S. L. and E., F.L.S., F.G.S., M.R.I.A., F.A.S., F.W.S., and F.H.S. (Edinburgh), Regius Professor of Natural History, Lecturer on Mineralogy and Keeper of the Museum in the University of Edinburgh, and Editor of the "Edinburgh New Philosophical Journal." Under this gentleman of forty-three titles, who was severely but not unjustly scourged by Waterton, Darwin "does not seem to have profited at all by whatever instruction he received; for not only did it fail to awaken in him any special love for Natural History, but even seems to have had the contrary effect." This was, for him and for Science, a most fortunate escape. Had he, at the plastic age of seventeen or eighteen, attached himself to Jameson, he might have become a normal high and dry "Brodgelehrter," zealously discussing "good" and "bad" species and studying Biology from ill-stuffed specimens, but never the great re-creator of Natural History. To awaken the sacred thirst for truth in the mind of young Darwin was reserved for a man far greater than Jameson, though less pretentious—Prof. Henslow, of Cambridge.

We are here naturally led to the question of precocity. Did Darwin, like so many other naturalists, show in boyhood a disposition to collect and study insects, plants, or other specimens? Here Mr. Romanes gives an uncertain sound. He writes:—"As he [Darwin] used himself to say before he knew Prof. Henslow, the only objects of Natural History for which he cared were foxes and partridges. But owing to the impulse which he derived from the field excursions of the Henslow class he became while at Cambridge an ardent collector, especially in the region of Entomology." Elsewhere, however, Mr. Romanes quotes a letter of Darwin's, in which the latter says—"I went to Cambridge early in the year 1828, and soon became acquainted, through some of my brother entomologists, with Prof. Henslow; for all who cared for any branch of Natural History were equally encouraged by him." Here, then, we have distinct evidence that Darwin was already an entomologist prior to his acquaintance with Prof. Henslow. But we need merely read the whole of the letter referred to in order to find that Prof. Henslow exerted upon him a most powerful and salutary influence. The friendship which sprung up between them was indeed broken off only by death. It was upon Henslow's advice that he seized the opportunity of joining the surveying voyage of the *Beagle*.

Three perils were thus overpast. He had escaped becoming a routine naturalist of the Old School, a practising physician, or a country clergyman, carrying on the study of Entomology as a recreation. Another danger which he would have encountered in our days was non-existent. He never "passed" or "prepared for" an examination in any department of Natural History. He learned simply in order to know, and the result was great accordingly.

The account of Darwin's work in Geology—or, as it would perhaps be better expressed, his influence upon Geology—is furnished by no less an authority than the Director-General of the Geological Survey, Dr. Archibald Geikie, F.R.S. He lays emphasis on the fact that Darwin's discoveries, if fatal to catastrophism, are far from supporting uniformitarianism. "That the present must be taken as a guide to the past has been more fearlessly asserted than ever. And yet it has been recognised that the present differs widely from the past; that there has been a progress everywhere; that Evolution, and not Uniformity, has been the law by which geological evidence has been governed." If not the first to recognise the incompleteness of the geological record, he first convinced the world of its necessarily fragmentary character. He showed the fallacious nature of the assumption that the stages of the record "were sharply marked off by the first appearance and final disappearance of certain species." He first suggested that the geographical distribution of animals and plants throws a light on the changes of land and sea. How fruitful this hint has proved is universally known.

As a botanist Darwin's work is estimated by Mr. W. T. Dyer, F.R.S., Assistant-Director of the Kew Gardens. Here, too, the indirect effect of the Doctrine of Development must be pronounced more weighty than the direct results of Darwin's own contributions. But though he always disclaimed the right to be regarded as a botanical specialist, Mr. Dyer rightly says that each of his botanical investigations, taken on its own merits, would alone have made the reputation of any ordinary botanist. He detected, analysed, and interpreted phenomena which the professed botanical world had for the most part overlooked. We need merely refer to his studies on circumnutation, on the fructification of orchids, on hybridism, and on the distribution of plants. Particular attention is called here to the warm enthusiasm, the passionate joy in Nature which he shared with Linnæus and Humboldt, and which he complains is wanting in the narrower being of some of our more recent naturalists.

Darwin's greatness is, however, most fully shown in his work on Zoology. Mr. Romanes well says "He was able to appreciate and successfully to cultivate every department of biological research,—whether morphological, physiological, systematic, descriptive, or statistical,—and at the same time to rise above the *minutiæ* of these various branches to take those commanding views of the whole range of Nature and natural science which have produced so enormous a change in our means of knowledge and our modes of thought. No labourer in the field of Science has ever plodded more patiently through masses of small detail; no master-mind on the highest elevation of philosophy has ever grasped more world-transforming truth."

Darwin's elaborate monograph on the *Cirripedia* is referred to as proof that had he confined himself to morphology he would have been unsurpassed in that speciality, and as proof that he was not the amateur which certain French official *savans* rashly pronounced him. But Mr. Romanes adds that it would have been a calamity in the history of our race if Charles Darwin had been tempted to become a comparative anatomist. Such work he did well to leave to men who, though great, are still far his inferiors.

Mr. Romanes sums up this part of the subject by quoting the conclusion of the "Origin of Species," which does not seem, to him, a subterfuge.

The last section of the little work, from the same pen, views Darwin as a psychologist. In this department his direct contributions are limited to one chapter in the "Origin of Species," three chapters in the "Descent of Man," and a short paper on the development of infantile intelligence. Moreover, he was indifferent to the verbal subtleties of the official psychologists who approach this subject from a metaphysical side. Hence by them he was regarded at first as a presumptuous outsider. Nevertheless he shook their science to its base, and left them humbler, and we would fain hope wiser, men.

In drawing to a close Mr. Romanes expresses a "regret that the ill health which led to his seclusion prevented the extraordinary beauty of his character from being more generally known by personal intercourse." We regret that he was, ever since his voyage in the *Beagle*, a sufferer. At the same time we cannot help suspecting that these very sufferings and the seclusion which they occasioned were not unmixed evils. A wider range of personal acquaintance might have distracted him from his grand life-task, and perhaps have even led him to waste his time and his energies in work for which inferior minds are quite competent.

What is wanting in the work before us is a general estimate of Darwin's influence, not in this or the other branch of Science, but upon the whole horizon of human thought. This task, perhaps, may advantageously be postponed till the seeds sown by him and his disciples shall have sprung up and borne fruit.

IV. AN UNWELCOME TRUTH.

By An Old Technologist.

NOT very long ago the farmer was told by eminent agricultural chemists that he ought to know at all times what quantity of plant-food existed in his fields, so that he might at once see how much and what kind of manure need be added to meet the requirements of any crop intended to be planted. It was laid down that if the soils were carefully analysed at the outset, and if the weight and composition of the manures employed were added, and, on the other hand, the weight and composition of the crops taken from the fields year by year, a balance might be struck at the end of any season, showing how much combined nitrogen, phosphoric acid, potash, &c., remained on the soil. The whole affair had about it an appearance of beautiful simplicity. It was of course admitted that fertilising matters present in a soluble condition might be washed away in the drainage in a wet season. No one would have attempted to deny that ammonia, if present in the free state, or if combined with carbonic acid, must to some extent escape into the air. And it was also no secret that not all the mineral plant-food found in the soil, on chemical analysis, was present in an available condition. But the extent and importance of these drawbacks have only quite recently been placed before all concerned in a distinct light.

It is only just to say that the results reached are unpleasant and unwelcome. Still nothing can be gained by ignoring facts, especially when they affect the entire population of all civilised countries.

It has been established, by the researches of M. P. P. Dehérain, that—at least as far as combined nitrogen is concerned—the amount of plant-food removed from arable land by the crops is neither the whole, nor in many cases the greater part of the yearly loss. Given the original analysis of the soil, the weight and analysis of the manures added and of the harvests taken away, we cannot find the amount of plant-food remaining. An important factor has been left out of the account.

M. Dehérain began, in the year 1875, a series of experiments at the Agricultural Station at Grignon. The soil of a field was, to begin with, thoroughly analysed. The field was then divided into plots; certain of these were plentifully dressed with farmyard manure, others with sulphate of ammonia or soda saltpetre, whilst others, again, remained unmanured. All these three kinds of plots were planted with maize and potatoes for seven years in succession, and at the end of the last season the results were made known. In what state was the soil of these experimental plots?

Had this question been submitted to an agricultural chemist of the year 1850, he would doubtless have replied that the unmanured portions of land would be found decidedly impoverished, whilst the manured portions would—at least as far as combined nitrogen is concerned—have become no poorer, or, if the supply had been sufficiently plentiful, might even have been enriched. As early as 1878 it was found that the loss to the soil was very much greater than would follow from the combined nitrogen carried away in the crops. Not merely the unmanured plots, but those which had received sulphate of ammonia and soda saltpetre were found distinctly impoverished. Those plots, on the other hand, which had been dressed with farmyard manure had grown somewhat richer. But it must be distinctly understood that they also had not retained the entire supply of nitrogen over and above that consumed by the crop. Hence it would appear that if nitrogen is supplied to the land in a readily soluble form, as in the salts above mentioned, a very considerable proportion is lost. It dissolves in the rain-water, soaks down into the drains, and passes away into the rivers.

But M. Dehérain draws from his experiments a further conclusion—the more plentiful the manuring the greater is the loss. This appears from the fact that from 1878 to 1881 the cultivation of maize was continued, but wheat was grown instead of potatoes, and the supply of manures was brought to an end. The crops were weighed yearly as before, and the soil was analysed in the year 1881. A loss of combined nitrogen was still apparent, greater in quantity than that consumed by and carried off in the crops. But the yearly loss was smaller than it had been during the years of copious manuring.

A third point which became apparent, though perfectly in accordance with known chemical laws, is equally unwelcome. These losses of nitrogen ceased when the land was no longer subject to yearly cultivation, but was converted into an artificial meadow. From 1875 to 1879 a series of plots had been yearly planted with beets, and in the last year the soil, on analysis, was found to be impoverished to a noteworthy degree. Then sainfoin was substituted for the beets, and, although no manure was given and three good crops were taken off, the soil was found in 1881 to be not only not impoverished, but slightly enriched.

M. Dehérain infers that the method of cultivation adopted has a greater influence upon the richness of the soil than the manure supplied and the crops taken away. The experiments conducted at Grignon lead to this significant result —arable land in constant, regular cultivation, cannot be enriched by large applications of soluble manures. The improvement which is produced by farmyard manure—and consequently by other less readily soluble manurial matters, such as fish, dried blood, powdered horns and hoofs—is but transitory, and soon disappears if the soil is broken up and disturbed every year by the work of the plough. If the soil is left undisturbed it does not become impoverished, although yielding abundant crops.

These facts not merely agree with the results of other investigators,—I may especially mention Messrs. Lawes and Gilbert,—but are readily intelligible if we consider the effects of cultivation. The more the soil is broken up by the plough or the spade, the more pervious it becomes to air and water. In consequence nitrogenous bodies are quickly decomposed, and their nitrogen, under the oxidising action of the air, assumes the state of nitrates. These nitrates, being readily soluble, are dissolved by every shower of rain, and carried away as already explained.

This view of the case is simply alarming, and necessitates the question—How can a progressive deterioration of the soil, leading to ultimate sterility, be avoided or retarded ?

The circumstance which M. Dehérain mentions, that the impoverishment of the soil is arrrested if it is let alone, is, as a consolation, perfectly nugatory. The crops of which human food consists—at least in all the colder parts of the earth—are annual, and require a yearly ploughing. I need only mention all the kinds of corn, potatoes and other esculent roots, and the leguminous plants and herbs of the cabbage tribe. We cannot subsist upon the produce of orchards, both because of its precarious nature, and because during a great part of the year it necessarily fails us.

Pasturage and meadows, natural or artificial, do not meet the difficulty. A scanty population may indeed be supported on meat, milk, and other animal products ; but as a country becomes more civilised and more densely inhabited, the relative number of cattle and sheep necessarily decreases, and the people are more and more driven to a vegetable diet. Without at all adopting the extreme views of the so-called dietetic reformers, I must recognise that a progressive disuse of animal food is going on in most civilised countries. Nor can I forget the unfavourable influence of a pastoral life upon civilisation and morality. A nation of herdsmen, if it multiplies, is compelled to encroach upon its neighbours, and is always in a state of barbarism.

As for the intellectual state of such communities, I need merely point to the grazing districts of England. There are people who do little or nothing but drive cattle into a field and fetch them out again. Their fathers for five hundred years back have done the same, and any native who has ideas beyond bullocks leaves the neighbourhood and settles elsewhere.

The land cannot, therefore, be left undisturbed, unless we are prepared to return to a state of semi-barbarism. The population of Europe is already far greater than its area could support as herdsmen and shepherds. But it is possible, or rather probable, that there is a certain point up to which tillage may be carried with comparative safety, whilst if such point is exceeded the crops are not so much benefitted by the comminution of the soil as injured by the greater facility given to the waste of plant-food. This golden mean should be ascertained.

Again, it is generally asserted—though I could not at the moment lay my hands upon direct proofs to that effect—that soil, manure, season, and seed being the same, land tilled with the spade yields heavier crops than such as is under the plough. Has it been ascertained what is the comparative effect of these two methods of cultivation upon the soil? The spade breaks up the soil better than does the plough. Does it facilitate the waste of manurial matters to a greater degree, and lead more quickly to exhaustion?

Again, drainage is a necessity. Even with it we find, in a wet season like the past winter, the seed rotting in the ground. But is the facility for the escape of water from the soil, carrying with it of course such soluble matters as it meets with, not sometimes unduly increased? Here, probably, a golden mean should be sought for and observed.

The kind of manures applied has also to be taken into consideration. The two saline manures used by M. Dehérain in his experiments are exceedingly soluble, and when he employed farmyard manure, which is less soluble, the waste experienced was smaller, or in some cases gave place to a small improvement. It must here be asked, What is the key to the great difference traceable between the arable lands of Western Asia, Northern Africa, and Europe on the one hand, and those of China and Japan on the other? The former group has, as we well know, received for centuries the manure produced in the farmyard, and has in most places become impoverished to a greater or less extent; but in China, where the bulk of the land has been under regular cultivation for probably two thousand years at least, where there is little or no pasture or meadow land, whether natural or artificial, and where the chief manure consists of human excreta, the soil under this treatment is said not to have become deteriorated or exhausted. Of course no analysis of Chinese soils, as they existed from 2000 to 3000 years ago, are to be procured; but there is no reason to suppose that they were at the outset richer than those of the rest of the world. We know that the soil was let alone, and we can only therefore infer that their manuring has kept up the fertility of the land.

This brings me to the question of sewage-irrigation. It has been admitted, as far as I am aware, by one of the arch-advocates of this method of disposing of fœcal matters, that two-thirds of the combined nitrogen present in the sewage may, instead of being retained by the soil, pass out in the effluent water. This statement, in the light of the experiments of M. Dehérain, becomes highly probable.

Nitrogenous matter dissolved or suspended in a large excess of water, and passed through a porous medium, such as the soil, can scarcely fail to undergo decomposition, the ultimate product being nitrates. Hence it will appear that sewage irrigation must for ever fail in utilising the whole, or even the greater part, of the nitrogen present in human excreta. In sewage precipitation, on the contrary, much of the "organic nitrogen" of the Franklandians, or the "albumenoid ammonia" of the Wanklynites, forms a combination with alumina, and is only gradually rendered soluble in the soil. In this manner it is much more likely to minister to the wants of a growing crop.

The double objection to the old method of dealing with sewage, *i.e.*, running it into the nearest river, is that it wastes manurial matter, and that it renders the water of such river what is now called a "culture solution"—that is, a liquid in which Bacteria, of sorts, if once introduced may increase and multiply. But the difficulty of dealing with this double evil now appears. If we turn the sewage of a town, not directly into a river, but pass it over an irrigation field, the bulk of the combined nitrogen still finds its way into the stream and is wasted. From the sanitary point of view the case is not very much better. True, a very dilute solution of alkaline nitrates will not, so far as is known, have any directly injurious action upon the health of men or animals who may drink it. But should disease germs be introduced into the stream—a contingency which can never be absolutely excluded—they will find in it abundant pabulum. Even in the absence of sewage irrigation a stream flowing through manured and cultivated lands can never, if M. Dehérain's experiments be trustworthy, be absolutely free from nitrates. Phosphoric acid will probably be also present, if, at least, wet weather should quickly follow the application to the fields adjoining of a manure rich in soluble phosphates. This will be especially probable if the soil is poor in carbonates of lime or magnesia. From my own observations I am inclined to think that if sanitary chemists would search more generally and carefully for phosphoric acid in the water of streams, ditches, and drains, they would be not unfrequently successful.

I remark here that Dr. B. W. Richardson seems to regard the vast quantity of plant-food carried by rivers into the sea as a question not of capital moment. He contends that it is not lost, but is utilised in the production and maintenance of marine organisms. This view is in one sense perfectly justifiable. But whatever is withdrawn from immediate utilisation is, practically speaking, lost. Were all the plant-food thus poured into the sea retained upon the land, it might be made to circulate many times through the bodies of vegetables and animals in less time than it can be recovered from the sea in the form of fish for human food, or fish-manure. For the marine animals which we use for either of these purposes do not feed directly upon the nitrates, the ammonia, and the phosphates which we pour into the sea. These bodies serve firstly for the nutrition of marine plants, and it is only after a long series of transformations that they enter the cycle of human wants and applications.

Perhaps the results of M. Dehérain may help us to understand the function of humus. No one, after the many experiments and investigations which have been carried out will return to the old notion that it furnishes plants with any direct nutriment. But by supplying carbon to the oxygen of the air it may retard the oxidising action of the latter upon nitrogenous compounds. Its powers of absorption and retention also will probably prevent the nitrates when actually formed, and the other soluble constituents of plant-food, from being conveyed away as rapidly as will be the case in soils poor in organic matter.

It is curious to contrast the conclusions of M. Dehérain with, *e.g.*, the views of Jethro Tull, who maintained that the fertility of a soil was capable of being improved and maintained indefinitely by constant turning over and pulverisation.

V. FLOWERS AND INSECTS.

By J. W. Slater.

ONE of the most popular and interesting portions of the New Natural History is that which discusses the relations between flowers, on the one hand, and insects and certain birds on the other. But its very interest and importance, not less than the support which it lends to the Doctrine of Descent, secure for it in some quarters an obstinate opposition. This hostility, as might be expected, is met with chiefly in France, where official science and alethophobia still shut their eyes to the constantly accumulating evidence in favour of Evolution.

The case, as presented by Darwin and his followers, is this:—It has been experimentally proved that in plants the close relationship of the sexual cells is unfavourable to the reproduction of the species. If the pollen of a flower has been applied to the stigma of the same flower (self-fertilisation) the seeds will prove less productive and give rise to less vigorous plants than if they had been "cross-fertilised"—*i.e.*, if there had been applied to them the pollen either of a different flower of the same plant or of a flower of another plant. It is, further, beyond dispute that in many flowers there exist formal obstacles to self-fertilisation which might even be regarded as special contrivances for its prevention. Sometimes the male organs of a flower come to perfection not at the same time with its female organs, but either sooner or later, so that the stigma can only be acted upon by pollen from some other flower. In other cases there are mechanical arrangements which prevent the pollen of a flower from being applied to its own stigma. Hence it is plain that if fertilisation is to be effected at all—which is an absolute necessity—pollen must be conveyed to it by some special agency. Of such agencies we know only two—the wind and certain living beings, especially insects. That insects do take an active part in the fecundation of certain flowers we have very complete proof. We find that flowers are abundantly visited by insects belonging to various orders, especially butterflies, moths, bees, some wasps, Diptera (especially those belonging to the family of Syrphidæ), and a few flower-haunting beetles. We observe in plants a variety of arrangements by means of which insects visiting the flowers are sure to carry off a quantity of the pollen adhering to their wings, which is then transferred to the stigmata of the next flowers visited. On the other hand, we notice varied and complicated arrangements for keeping off such insects as would, from the nature of their habits, not subserve the great work of fecundation. This fact was first observed and recorded by the late Thomas Belt, and has since been studied in detail by Prof. A. Kerner, whose "Flowers and their Unbidden Guests" gives full information on the subject. Some of the habits of insects seem to have a decided reference to the fecundation of plants. Not a few forms, in their search for honey and pollen, confine themselves to one species of plant, or at least to one type. Others, though not thus limited,—*e.g.*, the common honey-bee,—do not visit all flowers promiscuously, but devote themselves on each journey to some species of flower. Lastly must come the most decisive piece of evidence, that in the absence of certain insects flowers are unable to mature their seeds. To enable the red clover to reproduce itself, in New Zealand, it has been found necessary to import humble-bees. So far, then, the most obstinate votary of the Old Natural History can find no pretext for dissent or doubt. But it has been found practicable and necessary, taking the above-mentioned facts as a basis, to go much further. It has been observed that whilst some plants—hence called anemophilous—are so constructed that they may readily be fertilised by the pollen of other plants as conveyed by the wind, in others this kind of fecundation is impossible or highly difficult, and the services of insects or of birds are necessary. These latter plants, known as entomophilous, if compared with the anemophilous group, present certain well-marked characteristics. They offer distinct and often brilliant masses of colour, or in place thereof they give off a striking odour. This is not the case with the anemophilous plants. In them the calyx and corolla, which in the entomophilous plants are the seat of colour, are wanting. Hence in popular language they are said to have no flowers. To this day many people laugh if we speak of the flowers of an oak, an ash, or a fir.

We next notice—as it has been proved by Sir John Lubbock in numerous and elaborate experiments—that insects, and especially bees, possess a sense for colour, and not only distinguish one hue from another, but have their preferences. That they have a delicacy and a discrimination of scent far surpassing that of the bloodhound needs no demonstration. It appears, further, that powerful odours and brilliant colours are very rarely combined, but seem mutually to substitute each other. Hence the conclusion is drawn that both the colours and the odours of flowers serve to attract insects, and thus to ensure fecundation. The more bright and conspicuous a flower the more readily it is seen by bees and butterflies, and the more likely it is to be visited. Hence a number of the peculiarities of the vegetable world become intelligible which would otherwise be unmeaning. The cowslip, as Mr. Grant Allen has recently pointed out, carries its flowers on a stiff and relatively tall stem, because it grows on level ground. The primrose, with its slender drooping stem, prefers the slopes of banks and hillocks, and has a larger and brighter flower. Our ordinary heaths and wild thyme have exceedingly small flowers, and form a low carpet over the ground; but they grow where they are not overshadowed by trees or bushes, and their individual blossoms are so numerous and closely-set together that they cannot easily be overlooked. The foxglove haunts the woods, the coppices, and the sides and interstices of rocks; hence to be visible it requires a tall stem and fairly-sized richly-coloured blossoms. The poppy, like the cowslip and the primrose, is an inhabitant of the fields; but it flowers not in early spring, but when the grass and corn have grown high enough to hide any lowly plant: hence we see its intense scarlet cup supported by a moderately tall stem.

In our northern regions few large trees bear conspicuous flowers, and in accordance with this circumstance we see the bees, the butterflies, and the moths skimming and fluttering at a moderate height. In tropical forests all below is often poor alike in animal and vegetable life, whilst huge and brilliant flowers are basking in the sunshine high overhead, and there accordingly such magnificent forms as the Papilios and Ornithopteras keep them company.

So far, again, the opponents of Evolutionism can allege little in objection. They may dislike the inferences to which experiment and observation obviously lead, but the facts themselves are scarcely to be gainsaid.

But we come now to the last step. Putting all the above considerations together most naturalists infer that in earlier ages plants were self-fertilised as certain of the flower forms still are; that anemophilous plants mark in some cases the next steps in advance, or possibly in others a decline from the ultimate or entomophilous state; that the brilliant infloration of the higher plants has been gradually evolved in the course of the struggle for existence. The more colour a plant displayed the more certainly it would be visited by the bee and the butterfly; the more certain these visits the greater is the probability of cross-fertilisation, and consequently the chance of the production of viable seeds.

Here, however, as we might expect, a variety of voices are raised in opposition. Among those who seek to controvert the views above expounded on the part played by insects in the fecundation of flowers, a prominent position is taken by a French botanist, M. Ed. Heckel. This gentleman, who must not be confounded with Prof. Ernest Haeckel, of the University of Jena, contends that the colours of flowers have not been evolved with any relation to the perceptions of insects. He calls attention to the brightness and purity of colour displayed by the Alpine flora—an indisputable fact. He then goes on to maintain that in the elevated mountain regions bordering on glaciers and snow-fields, insects are either wanting or are at least too few to play the part assigned to them by Darwin, Sir J. Lubbock, Dr. Fritz Müller, Mr. Grant Allen, and a host of well-known observers, English, German, and American.

On the other hand, M. Ch. Musset, after four years of observation in the Alps of Dauphiné, confirms the views of Darwin and his coadjutors, and refutes M. Heckel's assertion as to the absence or extreme rarity of insects at great altitudes. He shows that all the different orders of insects are fairly represented up to about 7000 feet above the level of the sea,—the altitude of course varying with climate and exposure,—and that even at greater heights the Lepidoptera, Hymenoptera, and Diptera were more numerous than the other orders. But the groups mentioned are precisely the flower-frequenters, whilst the Neuroptera, Orthoptera, and Hemiptera contribute little or nothing to the fecundating process, so that their absence or scarcity is from this point of view of no importance. The number of honey-loving insects was, in short, proportionate to that of flowers.

We must pay especial attention to the reply of M. Heckel. He does not seek to deal with the facts of M. Musset, nor does he adduce any counter-observations. He writes:—"I persist in maintaining that fecundating insects are not in any manner the cause of the luxuriance of the floral system in some Alpine species." If we were to pronounce this a typical specimen of Anti-Evolutionist reasoning we should not improbably be accused in certain quarters of "intolerance." We will therefore leave it to the judgment of our readers, and pass on to an argument which M. Heckel vouchsafes to bring forward. He submits that if the especial beauty of the Alpine flora is due to the action of insects they must be present not merely in moderate quantities, but actually in greater numbers than in the low grounds, which M. Musset does not assert! This strange plea convinces us that M. Heckel does not take the trouble to understand, or at least fairly to represent the workings of the struggle for existence. If butterflies and bees were entirely absent, of course they could have no action, and the colouration of the flowers would neither be assumed nor modified to suit their perception. But are we therefore warranted in concluding that the more numerous these insects are the greater will be the effect produced? Decidedly not: if the honey-loving insects become very numerous their influence will substantially cease. In their eager quest for honey every flower, whether conspicuous or otherwise, will be visited. Those of bright and pure colour will cease to have any marked advantage over such as are dull and ordinary. There will hence be no reason why a flower more brilliant than others of its species should have any advantage over them in securing cross-fertilisation, and consequently in leaving more numerous descendants. But let us suppose, as is actually the case, certain plants growing about the very margins of perpetual snow. Bees and butterflies will not be too eager to make a very minute search in regions so closely bordering on the absence of life. But if they espy from afar, *e.g.*, an Alpine pink, they will hasten to it at once, and secure its cross-fertilisation. Thus the more brilliant a flower the more certain it is to effect the object of its existence. The most beautiful will be selected and the dullest overlooked far more certainly than in some region where the swarm of insect visitors was greater.

We may here mention that, according to Sir Robert Schomburgk, there exists on the mountains of British

Guayana an exceedingly rich flora, with but a very scanty fauna as far as insects are concerned. This assertion needs further examination. Waterton had previously visited the same regions, but he has unfortunately left nothing on record which might throw any direct light upon the question, though he states in the "Wanderings" that "almost every flower of tropical climates contains insects of one kind or other," and generally speaking the mountainous parts of the Neotropical region are by no means poor in insects adapted for visiting flowers.

It may be asked to what cause does M. Heckel himself ascribe the brilliance and purity of the Alpine flora? He seeks their origin in "the solar radiations, which are more intense than in plains."

Before at all accepting this explanation we must pause and ask whether the brilliant colouration of the organisms in any country bears a fixed relation to the clearness of its skies and the intensity of its illumination? There is—to put the case in the most cautious and moderate manner—no evidence to this effect. The brilliant skies of Persia, Arabia, and the Sahara, free as they are from fog and cloud, have not fostered a brilliant flora and fauna. On the contrary, in those regions everything seems to tend towards what may well be called "desert-colour." On the other hand, the Cape of Good Hope has—or rather had, for the goats have destroyed it—a far more brilliant flora.

There is another fact to be considered and accounted for: what of the Alpine fauna? If the intensity of the solar radiations produces brilliant colouration in plants, should it not have a similar effect upon insects? Yet this is precisely what is not recognised. M. Heller remarks that, with the exception of the Chrysomelidæ, most Alpine insects are black or deep brown, and the higher we ascend the more sombre grow their colours. In other animals a similar tendency to melanism prevails. The fish in Alpine lakes have chiefly dark colours. Similarly among reptiles we find the jet-black *Salamandra atra* taking the place of the orange-blotched *S. maculata* of the plains. The common viper takes in high mountains an almost black colouration, and was formerly looked upon as a distinct "good species," under the name *Berus prester*.

But whilst the dark and dull character of the Alpine fauna militates decidedly against the above-mentioned hypothesis of M. Heckel, it is equally little in favour of the well-known views of Mr. Grant Allen. This able observer suggests that brilliance and purity of colour in the animal world is to be found mainly among such groups as inhabit, dwell among, or feed upon flowers and fruits. He considers that every creature naturally comes to admire the objects from which it derives its nutriment. The tastes thus formed would then, through the medium of sexual selection, gradually act upon the species until those splendid colours were produced which we now so much admire in birds and insects. Exception has already been taken to this hypothesis from several points of view. But it seems that the brilliant flora of the Alps, taken in connection with its sombre insect fauna, is the most serious objection yet brought forward. The Alpine Lepidoptera and Hymenoptera, visiting and deriving their supply of honey and pollen from a brighter flora than that of the plains, should, if Mr. Grant Allen's theory be true, surpass their lowland representatives in gayness of colouration. That the contrary rule should prevail seems fatal to the hypothesis in question.

VI. EPPING FOREST: A CONGRATULATION AND A WARNING.

IT is rarely indeed that the proceedings of Parliament claim our attention. We must, however, take leave to express the satisfaction which will be felt by all naturalists at the recent defeat of the proposed branch of the Great Eastern Railway from Chingford to High Beech. Lord Claud Hamilton's sneer at the "butterfly hunters" has been answered by a majority of 120 votes. For the rejection of this piece of wanton intrusion and spoliation we are in no small degree indebted to the watchfulness and devotion of Mr. R. Meldola, F.R.A.S., who has communicated with the Natural History Societies of London and the suburbs, and brought their united influence to a focus. His most able address on this subject, delivered before the "Essex Field Club" on February 24th and reprinted in the "Essex Times," has made a deep impression.

It would be, indeed, difficult to find a project with less questionable claims to public utility. We are told that no part of the forest is at present beyond the distance of one and a half mile from a railway station, whilst from Loughton a good road—crowded at holiday time with public conveyances—leads to the very High Beech which certain philanthropists think not sufficiently accessible.

Tavern accommodation, too, is ample. We have heard it whispered that there are certain plots of freehold land near High Beech, which, should the railway lately proposed be sanctioned, would greatly rise in value, for the very purpose of erecting more houses for the sale of intoxicants. It is said that this prospect is not unconnected with the piece of Vandalism which the House of Commons has for this season disposed of. Now we think it may safely be asserted that the more taverns are allowed to spring up in and near the Forest, the more disorder will take place, and the more the "rough" element will be attracted to the locality to the annoyance and disgust of all decent people, whether "butterfly hunters" or not. We think that from this point of view the friends of Temperance might wisely co-operate with the lovers of Nature in seeking to prevent any further desecration of the Forest. For those whose main holiday amusement consists in being drunk "with drunken knaves" there is already, both in London and its outskirts, most ample provision.

But there is a further danger: even supposing railway-directors and tram-companies are for ever debarred from encroaching upon the Forest, we may possibly find that by substituting the reign of the so-called Conservators for that of lords of the manors we have merely exchanged King Log for King Stork. The encroachers gradually stole the land, but they did not spoil what was left. Now, as one of our contributors endeavoured to show in our number for June, 1882 (page 341), and as Mr. Meldola has explained more clearly in his paper above mentioned, the action of the Conservators has been directed not to the preservation of the Forest in its original state, but to its "artificialisation,"—*i.e.*, its conversion into a "peoples' park." Now parks, "peoples'" or otherwise, exist already about London in considerable numbers, and, as compared with streets and houses, they are a relief to the eye. But as compared with a piece of natural forest they are to the last degree tame, formal, and monotonous. The Conservators, instead of ruining the Forest and banishing its native flora and fauna by deep draining, removal of thickets, and cutting formal roads, might find much better scope for their energies and their funds in replanting those parts which had fallen into the hands of encroachers, and are now mere barren wastes. By so doing, and by simply letting the wooded parts alone, they will afford the greatest pleasure to the greatest number. The damage they have already committed is far from unimportant, and it is time that their injudicious hands were arrested.

ANALYSES OF BOOKS.

*Der Darwinismus und seine Consequenzen in wissenschaftlicher und socialer Beziehung.** By Dr. EUGEN DREHER. Halle: C. E. M. Pfeffer.

WE have here a thoughtful and elaborate investigation of the scientific and social consequences of Darwinism, or, as we should say, Evolutionism. The author, an adherent and admirer of Darwin, writes not as a specialist, but as a philosopher. Whilst fully recognising the importance of the "Doctrine of Descent," in Zoology, Botany, Palæontology, Geology, &c., he takes a wider view. He asks what light the researches of our Great Master have thrown upon the problem of life, and upon the Monistic and Dualistic interpretations of the universe? He shows the fertility of Evolutionism as regards the development of the so-called moral sciences, of ethics, æsthetics, and the yet rudimentary discipline to which Comte gave the name of Sociology. In this direction comparatively little has been done. With the exception of Mr. Herbert Spencer, of Mr. S. Tolver Preston, and Mr. F. Ram, the bulk of the writers in this country who have touched at all upon the ethical and social bearings of Evolutionism have contented themselves with representing it as tending to overturn the distinction between right and wrong, and generally to dissolve the very bonds of human society. Even in Germany it is painful to find that similar misconceptions exist. No less an authority than Prof. Virchow has sought to connect the unpleasant phenomenon known in Germany as "Social Democracy" with the rise and progress of the New Natural History.

Dr. Dreher, in his Introduction and in his first chapter, gives a clear, but necessarily concise, summary of the life-task of Darwin, of his forerunners,—among whom he singularly omits the great Oken,—and of his opponents. Among the latter he does not forget the "Brot gelehrten,"—trade-scientists,—the *savants* of centralising Academies and Departments, who from motives readily understood rarely fail to oppose any discovery of capital moment.

The author notes the importance of Haeckel's biogenetic law, according to which the individual in its embryotic career passes through what may be called a foreshortened series of the stages through which the species has travelled in its evolution.

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* Darwinism and its Consequences in their Scientific and Social Relation.

He refers, though briefly, to the bearings of the Darwinian reform upon practical medicine and hygiene, in which regions it solves not a few difficult problems, and then passes on to his more immediate subject.

What of the origin of life, abiogenesis, or, as it was formerly called, equivocal generation? Here he admits that upon this question Darwin has thrown no conclusive light. He does not for a moment contend that—either in experimental observations, or in Nature as far as man has been able to trace—life has ever originated from inorganic matter without the presence of seeds, germs, or ova derived from antecedent life. But he repels the contention that if a Higher Power, a Deity, has once interfered with the ordinary sequence of cause and effect, such intervention may have been repeated, and all the various animal and plant types may have been specially created. To this plea he makes answer that though a Divinity might have so acted, yet on careful examination of the facts we find abundant evidence that such has not been the case. "As Evolutionism discloses a relation of organic forms which agrees with our craving for causation we must decline, on the principle of parsimony, to explain by dint of supernatural, and to us incomprehensible, forces, results which can be satisfactorily accounted for by the every-day principles of heredity and adaptation." Darwin does not attempt to account for origins, but given organic life he endeavours to show how from it the animal and vegetable worlds, as we now see them, have been developed.

The suggestion, taken up by Prof. Helmholtz, and we believe by Sir W. Thomson, that the first germs of life have been conveyed to our planet in meteorites, he sets aside by a very obvious consideration, which has more than once been put forward in our columns. "This assumption," he writes, "serves nowise to explain the origin of life, since the problem is thereby merely removed. Whether life first originated upon our earth, or in the realms of space, or in meteorites, is for our purpose indifferent, since we ask not *where*, but *how* it first began." This hypothesis becomes intelligible only on the assumption that life has existed in the universe from all eternity, and is conveyed by a succession of accommodating meteorites, from exhausted worlds to such as are just ready to become the abodes of organic existence.

The author then turns to the considerations by which Prof. E. Haeckel seeks to connect the inorganic with the organic world. Here it will be necessary for us to indulge in a little delay. There are two, or more strictly speaking three, fundamental ways of regarding the world. Dualism—which the author adopts not as satisfactory, but as the least unsatisfactory—presents the two heterogeneous principles spirit and matter. It distinguishes them by pronouncing all spiritual processes as essentially non-spacial, whilst all material processes, as phenomena of motion, are not conceivable in the absence of space. Monism, on the other hand, teaches the unity of all that is. But this term is used in two very different acceptations. We have, on the one hand, Materialistic Monism, which recognises as the sole principle of all that takes place Matter, the something accessible to our senses. Spiritual operations are to the adherents of this school, in their essence, whether we may ever succeed or not in explaining them derived from material action. The other, or Pantheistic, school of Monism assumes as the unity of all being a something, the "substance" of Spinoza, which expresses itself in two forms, spirit and matter, the "attributes" of Spinoza. Individual beings are merely "modes" of this "substance."

It is the more important to know that this is the point of view which Haeckel adopts, as he is generally held up as a "Materialist," such adjectives as "crass" or "rank" being often thrown in. In a letter to the author he pointed out, some years ago, that the latter had raised against his interpretation of the universe "objections which might justly be advanced against one-sided Materialism." In fact Haeckel regards atoms as the smallest individualities, as each possessing a soul, and consequently, in however light a degree, as endowed with consciousness. He thus escapes the difficulty which the Materialists encounter, in deriving life and soul from a non-sentient, unconscious matter. He views crystals as the analogues of organisms or as the pristine organisms of the animated world. As the original organisms, in the common acceptation of the term, he regards not cells, but *Moneræ*. These he pronounces to be structureless, animated plasma.

The Materialist regards life as the simple result of matter under certain conditions. To him the spontaneous production of the higher animals only would seem improbable, as here the number of conditions which must coincide borders upon the impossible. This difficulty Darwin has certainly removed out of the way of Materialists by bringing the higher and the lower organisms into connection.

The author considers, however, that neither Monism nor Dualism is able to grasp the phenomena of life in a manner which shall satisfy the inbred and imperative demands of thought. Dualism is unable to explain how the non-spacial, the soul, acts upon the spacial or body, and conversely. It is also obliged to assume that the strict sequence of cause and effect, after having gone on for æons prior to the avatar of life, is suddenly interrupted by the introduction of a new factor ascribable only to a supernatural world. "Thus Dualism leads to the assumption of a God, and cuts off thereby the thread of further investigation, whilst we cannot help demanding for everything a natural cause. A First Cause, a *causa sui*,—whether we call it God, Nature, or Necessity,—is for us incomprehensible, since our whole thought is of phenomenal nature. The assumption of a supernatural principle is by no means banished from the research if we are led to it by consequent thought, based upon experience."

The monistic interpretation of the universe, whether pantheistic or materialistic, breaks down from its incapacity to explain from a unitary principle the difference between matter and spirit. The Pantheist is unable to explain the duality of matter and spirit, in which the One Substance appears to itself; the Materialist is incapable of showing how phenomena of motion can become spiritual processes. Hence it must be admitted that the above-mentioned interpretations of the world—the only ones which man can conceive—are not even able to grasp satisfactorily the phenomenal side of Nature, much less to admit of a conclusion as to the essence of the order of the world. The author, reminding his readers of the necessarily phenomenal character of our knowledge, views in Monism and Dualism schemes of the mind, each having a "one-sided justification" which we may recognise without raising against the former the charge of Atheism and immorality, or against the latter the accusation of credulity and superstition.

Whilst, however, thus seeking to recognise in each of these interpretations of the universe its valuable element, he declares himself an adherent of Dualism, founding his choice upon the doctrine of cognition. In this recognition of spirit and matter as the two substantial entities which make up the world, he follows the footsteps of Darwin, as it appears from the concluding passage of the "Origin of Species." He even considers—like not a few philosophic naturalists, both of his own country and of America—that Dualism will be of more service to the Darwinian than Monism. Combating the views of Haeckel, he emphasises the distinctions between the organism and organic individuals—crystals. He argues that no crystal is capable of reproduction. But we may here ask whether he has sufficiently borne in mind that, in the lower forms of life, reproduction, the increase of the species, is not so sharply differentiated from nutrition, the increase of the individual, as in the higher groups. Nor can we agree with him in maintaining that "every individual, even before its birth, carries in it the germs of death." We have some time ago shown that death is not the necessary lot of all living.

Whilst admitting the possibility that modern chemistry may succeed in the synthesis of all organic compounds, he maintains that, even were it possible to form artificially an entire animal, not merely chemically, but structurally, identical with those we meet with in the world, it would be a mere corpse, without an immaterial something. Nevertheless he holds that every vital process, regarded in itself, is the result of material processes, or, in other words, a phenomenon of motion.

In the remaining chapter, which the want of space prevents us from examining in detail, the author discusses, from an

Evolutionist point of view, the conscious and the unconscious element of the soul, memory, animal instinct, the struggle for existence between nations, necessity as the power impelling to improvement, and the pessimistic and optimistic side of Darwinism.

We have thus briefly expounded, without either seeking to advocate or to controvert, the principal portion of Dr. Dreher's views. Those of our readers who are anxious to get to the bottom of the Evolutionist philosophy will do well to give this book a most careful study.

The Gardens of the Sun; or a Naturalist's Journal on the Mountains and in the Forests and Swamps of Borneo and the Sulu Archipelago. By F. W. Burbidge, Trinity College Botanical Gardens, Dublin, and formerly of the Royal Gardens, Kew. London: John Murray.

Since the days of Arnold and Horsfield, and still more since the memorable expedition of Mr. A. R. Wallace, the Malay Archipelago has been for naturalists a veritable promised land. To those who, like ourselves, have not had the felicity of a personal sojourn in these islands, every faithful record of observations there is most warmly welcome.

The author of the book before us is evidently an able and enthusiastic botanist and plant-hunter. With animal life he is less conversant. We find here relatively little information on the distribution and the habits of birds and insects, and in comparative psychology Mr. Burbidge does not show to advantage. Of this the following passage is ample proof:—"After all the orang-utan is a poor creature, with but an outer resemblance to the human species. In intelligence he is not only far below the lowest savage, but even inferior to the horse or the dog. No amount of teaching will make the orang-utan or any other ape practically useful to man. Do all we can for them in a state of confinement they are simply big helpless monkeys to the last."

Anyone who has closely and candidly observed the mias or the chimpanzee in confinement cannot fail to perceive that, lacking all the advantages of hereditary training, and suffering from ill-health, as they invariably do in confinement, they are still vastly superior in intelligence to the horse, the dog, or the elephant. Whether or no they can be made "practically useful to man" is a totally irrelevant and non-scientific consideration.

Like Mr. Wallace, the author defends the natives of the Eastern Islands from random accusations. He maintains that there, whilst "Nature is ever beautiful, man, although often strikingly primitive, is hospitable to the stranger, and not often vile." Vileness, indeed, we may best find at home. The "rough" of our modern cities is, in most respects, a more degraded character than the barbarian.

We find it noticed that "one particular species of kingfisher always makes its nest in company with that of a colony of wild bees." The author suggests that its young may be fed on the larvæ, or perchance the company of the bees may be courted for the sake of their protection in case of the nest being attacked."

A very curious observation is made concerning *Nepenthes bicalcarata*, a new pitcher-plant discovered and introduced by the author. Its pitchers, which always contain insects of various kinds, are armed at their entrance with two sharp and strong spines. Mr. Burbidge is convinced that the spines serve to prevent birds and insect-hunting animals—such as the tarsier—from removing these insects, which doubtless serve as nourishment to the plant. The author has also observed the *Myrmecodia* described by Beccari, who asserts that unless the young seedlings are bitten by a species of ants which always inhabit the stems, they die. Mr. Burbidge is unable to confirm the view taken by the Italian naturalist.

Of Singapore, where the author made some stay on his outward journey, he gives a very elaborate description. He notes the rare and beautiful orchids which grow in cocoa-nut shells hung from the verandahs of the houses, the museum of the Raffles Institution, the Botanical Gardens, and the Chinese immigrants. Concerning the latter he remarks that "wherever they are admitted a strong hand is needed to keep them in order." On a visit to the mainland he notices the preparation of gambier, which he describes as "a very exhausting crop, literally ruining the land on which it is grown." In the jungles and on the rocks he obtained many interesting botanical specimens, and here he first made the acquaintance of the land-leeches. The argus and the fire-backed pheasant are noticed as common. In the Malay peninsula there exists a tribe who are commonly known as Orang-utan—a confusing practice: hence it is preferable to speak of the great ape of Borneo and Sumatra as the "mias." On his voyage to Borneo he saw a sea-snake, about 8 feet in length, basking on the surface of the water. This species is said to be very venomous, and occasionally to hide itself in boats or in huts near the shore.

In Borneo he finds a wonderful beauty and luxuriance of vegetation, but, except where a partial clearing had been made or a tree overthrown by a tempest, all the rarities, animal as well as vegetal, were high aloft. Every evening he was able to send his men home loaded with roots and specimens. He remarks that, for all the absence of law and government, the proportionate number of murders and robberies does not exceed the amount taking place in the centres of civilisation. Islam, from its inculcation of cleanliness and temperance, he considers a great blessing to many Eastern races. The gutta-percha trees, of which there are at least five species, are surely being extirpated in Borneo, as well as in the other islands. The caoutchouc from Borneo is also the mixed sap of three species of *Willughbeia*.

The ascent of Kina Balu, 9000 feet in height, proved exceedingly productive in botanical rarities, such as "Imperial Kew had longed for in vain." Luminous fungi were noticed glowing by night on the rotten sticks in the woods, but concerning the insect population of this region nothing is recorded.

In the island of Labuan the primeval forest has been devastated by fires, and much of its characteristic vegetation has disappeared. We doubt the supposition that it has been rendered healthier, as in most tropical regions epidemics such as cholera and yellow fever extend just in proportion as the country is cleared. Mr. Burbidge notes the sweet song of *Copsychus amœnus*, the only bird peculiar to Labuan. Several venomous snakes are mentioned, but fatal accidents from this cause are very rare. One species, not named, swallows smaller snakes, but can scarcely be on that account pronounced a cannibal unless it preys on its own species. The sun-birds he notes as representing the humming-birds of the Neotropical region. Like the latter they hover over our blossoms, but they perch more frequently, and often feed clinging by their feet, sometimes head downwards. The humming-birds, on the contrary, take their food whilst on the wing, as do the swifts, and among insects the Sphingidæ. The spiders are described as of "alarming size," but gaily coloured. There are oil-springs in Labuan, but the product is carelessly let flow to waste. The author describes some mason-wasps and large black carpenter-bees.

It is interesting to find that at heights of 7000 feet and upwards, on the Bornean mountains, Australian types of vegetation appear. A curious ethnological fact is that Malay and Bornean women, if married to Europeans, rarely bear children, and if they do the offspring of such unions are ordinarily incapable of reproduction. On the other hand, half-breeds between Chinese and Malays or Borneans are numerous and healthy.

Mr. Burbidge asks, "How comes it that none of our good landscape-painters ever visit the tropics, where the beauty of form and colour in the landscapes is more glorious than anywhere else?"—a question which we are disposed to echo.

At Sandakan, on his way to Sulu, the author met with Mr. W. B. Pryer, the well-known entomologist, who had made a splendid collection of Lepidoptera and Coleoptera, including several forms supposed to be new to Science. In the Sulu Islands he remarks the number, beauty, and variety of butterflies, but gives no clue as to the species, or even genera or families. He mentions, however, that an Ornithoptera, fully 6 inches across the wings, settled on his foot as he stood motionlessly watching it. It was of a velvet-black, with a band of pea-green across the wings.

In one of the last chapters of his book Mr. Burbidge gives an eloquent, but as far as we can learn by no means exaggerated, description of the native fruits of the Malay Islands, such as the mangosteen, durian, tarippe, langsat, rambutan, and jintawan. These are neither capable of production in European hothouses, nor do they succeed in other tropical countries. Thus the durian does not flourish in India, and has utterly failed in the West Indies. In like manner the mangosteen has failed both in India and the West Indies, and succeeds but imperfectly even in Ceylon. The mango is less limited in its distribution. It has been successfully acclimatised in India, Jamaica, and even in the Azores. "The shaddocks brought to Covent Garden from the West Indian Islands and the Azores are flavourless as a turnip when compared with those of Bangkok or Labuan."

The author's concluding hints on tropical travel are not without interest. He recommends three medicines, but as two of them are so-called "proprietary" articles we must decline to quote their names. He does not imitate Waterton's strange custom of walking barefoot, but enjoins good strong boots. Not being a collector of insects, land-shells, serpents, &c., he has no experience to communicate either as to the capture of specimens or on their safety in transit.

The appendices give a catalogue of ferns, fifty of which were new. Twenty species of birds were brought from the Sulu islands, among which rank a new jungle-cock (*Gallus stramineicollis*) and a new parroquet (*Tanygnanthus Burbidgei*). *Buchanga stigmatops*, a new species, was found on the Kina Balu mountain.

The flora of Borneo at high altitudes is said to be intermixed with Indian (*Rhododendron*) and Australian types (*Dacridium*, *Phyllocladus*, &c.). On Kina Balu, at the height of 6000 feet, was found a gigantic moss (*Dawsonia superba*), which has hitherto not been met with nearer than New Zealand. The number of plants discovered, and in many cases introduced alive, is remarkable, and warrants the conclusion that the expedition of Mr. Burbidge has been most remunerative. It is to be regretted that he was not accompanied by a zoological specialist, since, as he remarks, a very great part of Borneo is yet unexplored. To all students of Nature his book will be delightful reading.

The Electrical Researches of the Honourable Henry Cavendish, F.R.S., written between 1771 *and* 1781. Edited from the Original Manuscripts in possession of the Duke of Devonshire, K.G. By J. CLERK-MAXWELL, F.R.S. Cambridge: University Press.

As a matter of course these researches have now, a century after their production, an interest which is mainly historical. Henry Cavendish has always been to us a remarkable phenomenon. There have been men his equals and doubtless his superiors in intellect, but there probably never was a man in whom every other phase of human nature remained so exclusively in the back-ground, if indeed it could be said to exist at all. The hopes, the fears, the desires, the passions, and the temptations of ordinary men were in him conspicuous chiefly by their absence. He had no place on the ethical plane, which slopes from virtue down to vice. He was free even from the ambition, the vanity, the love of notoriety, and from the feelings of rivalry and envy which not a few *savans* manifest to a deplorable degree. An instinctive love for truth led him constantly to observe and to experiment with the utmost care and exactitude. But he was in no haste to publish his results. We read in the work before us: Cavendish cared more for investigation than for publication. He would undertake the most laborious researches to clear up a difficulty which no one but himself could appreciate, or was even aware of, and we cannot doubt that the result of his inquiries, when successful, gave him a certain degree of satisfaction. But it did not excite in him that desire to communicate the discovery to others which, in the case of ordinary men of science, generally ensures the publication of their results. How completely these researches of Cavendish remained unknown to other men of science is shown by the external history of electricity.

Thus Cavendish fell into an error opposite to that of our official scientists and Brodgelehrten, who in their haste to "take date," are said sometimes to mistake the researches of others for their own. But Cavendish was no "Brodgelehrter."

We have here a case of heredity. Lord Charles Cavendish, the father of Henry, was also an experimentalist of merit, and, like his son, cared little for publication. Dr. Franklin said of him: "It were to be wished that this noble philosopher would communicate more of his experiments to the world, as he makes many, and with great accuracy."

It is here noticed that, whilst Henry Cavendish had a wonderful power of making correct observations and getting accurate results with clumsy instruments, he had a less inventive genius in devising improved apparatus than some of his contemporaries. The extent to which he has anticipated the results of more recent physicists is remarkable. He not only anticipated

Faraday's discovery of the specific inductive capacity of different substances, but even determined its numerical value in several cases. As early as January, 1781, he anticipated the law of electric resistance, afterwards independently discovered by Ohm, and published by him in 1827. He experimented on the relative electric resistance of a series of acids and salts, and it is remarkable that the quantity of each substance used is "very nearly the equivalent weight of that substance in the system adopted at present, in which the atomic weight of hydrogen is taken as unity." The editor of the work before us thinks that, as these experiments were made in 1777, Cavendish must have obtained these numbers from determinations of his own, of the very existence of which we have no other indication.

In his memoir on the Torpedo, laid before the Royal Society in 1776, he treats of the different conductive powers, or rather of the resistances, of certain solids and liquids. He mentions that iron wire conducts about 400 million times better than rain or distilled water, and that sea-water, or a solution of 1 part of salt in 30 of water, conducts 100 times, and a saturated solution of sea-salt about 720 times better than rain-water. The editor remarks that this is equivalent to saying that iron wire conducts 555,555 times better than a saturated solution of sea-salt. At a temperature of about 11° C. (=52° F.) the ratio of the resistance, according to Matthiesen and Kohlrausch, would agree with that given by Cavendish.

In the memoir aforesaid an account of the methods by which these numbers were obtained was promised. But it has lain buried till the publication of these papers. Cavendish was his own galvanometer, and compared the intensity of currents by passing them through his own body. How by so rude a method he obtained so close an approximation to the truth is a marvel.

"The leading idea which distinguishes the electrical researches of Cavendish from those of his predecessors is the introduction of the phrase 'degree of electrification' with a clear scientific definition, which shows that it is precisely equivalent to what we now call potential."

Lord Stanhope's "Principles of Electricity," a work very popular at one time, was evidently written in entire ignorance of what Cavendish had done. The latter devotes two pages to the refutation of the theory of electric atmospheres, which is the basis of Stanhope's reasoning.

Much has been said concerning the extent to which the researches of Coulomb have been anticipated by Cavendish. It is here pointed out that the method by which Coulomb made direct measurements of the electric force at different distances, and that by which he compared the density of the surface-charge on different parts of conductors, were entirely his own, and were not anticipated by Cavendish. But the very idea of the capacity of a conductor as a subject of investigation is entirely due to Cavendish.

It cannot be doubted that had Cavendish been less reticent, and had he submitted his results to the world, electrical science would have made greater advances than it has at present.

The Weather of 1882 *as observed in the Neighbourhood of London, and Compared in all Respects with that of an Average Year.* By EDWARD MAWLEY, F.M.S., F.R.H.S., Hon. Sec. National Rose Society. London: Edward Stanford, and Williams and Strahan.

A CAREFUL examination of this little summary will convince the reader what careful and prolonged observation is required in order to give a correct notion of the climate of any country. The total yearly rainfall, the mean annual temperature, throw practically no light upon the influence of a climate on human health, and, what is perhaps even more important, on the growth of the plants necessary for our sustenance. We want to know whether the yearly rainfall is due to a few violent showers, or to sempiternal drizzle; whether the bulk of the downfall is in summer or in winter, in the night or in the day. As to the temperature we have, in like manner, to enquire whether the heat comes when it is wanted to mature the crops, or at some time when it can be of no service.

When we turn over Mr. Mawley's work, all wonder as to the frequency of bad seasons in England disappears, and we are almost led to marvel, on the contrary, how we ever come to have a good harvest at all. Of the three evil factors,—cold, wet, and wind,—it is seldom that all are simultaneously absent for an entire season. Our yearly mean temperature, 49½°, is not only very low, but it is too often made up not so much by good growing heat in summer as by the absence of frosts in winter. Our rainfall, though not large *per se*, is very high as compared with the insignificant evaporation under a cloudy sky, and it is administered in small but continuous doses, good, perhaps, for grass, but bad for almost every other crop. Perhaps the worst of the three factors is wind, which we have always in excess, though not always to such an extent as in the year 1882. The injurious effects of wind upon vegetation, though well known to gardeners, are quite overlooked by the general public. One main part of the advantages of cultivation under glass is that the crops are maintained in a calm atmosphere. It is certain that the extent to which the country has been denuded of trees has been in this respect a serious blunder. We endorse the recently-expressed opinion of an American contemporary that if we leave one-fourth of a country covered with wood, the remaining three-fourths will produce more food for man and beast than would the whole, if entirely stripped. Could we regulate the climate at will we should fix for the velocity of the wind from the appearance of the blossoms to the ingathering of the harvest a maximum of 5 miles per hour. Last year the hourly mean for the three summer months was above 12 miles. In compensation we had a calm in January, when it could merely serve for the production of fog. The most remarkable meteorological event of the year was the destructive gale of April 29th, which in a few short hours undid the work of what had up to that date been a most propitious spring. The mischief, too, was effected, not by our old enemy, the north-east, but by a south-westerly current. Nothing can prove more clearly the necessity of having the country intersected by belts of timber, preferably conifers.

The mean amount of cloud during the critical time, from the beginning of June to the middle of October, was above the average. Thus the sun was shut off to an unusual extent, and the ripening and gathering of corn, &c., were greatly interfered with. There is one point which we think meteorologists generally overlook, *i.e.*, the comparative cloudiness of the sky during the day and during the night. It can scarcely be denied by any one at all versed in physics that were the heavens during the spring and summer always overcast at night and always clear in the day, spring frosts would become exceedingly rare, and our summer temperature would be markedly improved. But, as far as can be decided by mere observation, in all our bad seasons the very reverse holds good. The sky clears up at nightfall, and the warmth of the earth is allowed to radiate freely into space. Soon after sun-rise the clouds collect again, and the soil and the atmosphere are hence deprived of the necessary supply of heat.

Mr. Mawley notices the general failure of hops, apples, pears, and plums, and the absence of flavour in bush-fruits and strawberries.

Bee-keeping proved unsuccessful, wasps were rare, the caterpillar of the gooseberry moth (*Abraxas grossulariata*) did very little damage, but Aphides and indeed all kinds of blight were unusually destructive.

Mr. Mawley's records of the weather taken in connection with their effects upon animal and vegetable life will be very valuable, not merely to scientific men, but to the practical farmer and gardener. We hope the author will receive due encouragement to persevere with his laborious task.

Longman's Magazine, No. V., March, 1883.

In the current number of this magazine we come upon a few matters which we may legitimately notice. "Bits of Oak Bark," a rural trilogy of Richard Jefferies, betrays the close and accurate observer of the fields and the woods. In its second part, "The Legend of a Gateway," we read how a lady heard the gallop of her lover's horse in the lane, and heard his peculiar whistle at the Gateway at the very moment when he was crushed to pieces at a level crossing some twelve miles away. Not a word reveals whether the quaintly-told story is an outgrowth of the writer's imagination, or a legend which it might be impossible to trace to its source, or an ow're true tale which could be verified with all the details of time, and place, and names. We can but repeat in comment that the introduction of such incidents in popular literature points to a decided change in the public taste. To what does this change point?

The same writer makes a passing remark worthy the notice of those who still maintain that beauty exists for man's entertainment. "I thought how the apple tree in blossom before us cared little enough who saw its glory. The branches were in bloom everywhere, at the top as well as at the sides; at the top where no one could see them but the swallows. They did not grow for human admiration: that was not their purpose." This reflection is the more significant as coming from one who is assuredly not collecting evidence against the old teleological school, which viewed everything in Nature as existing for man's use or delectation.

"Health in a Health Resort," by Dr. B. W. Richardson, though containing many valuable suggestions, leaves, after all, a deep feeling of sadness in the mind. For to what end is it to lengthen life unless the quality of life could be altered? After all, it is better to die of swift zymotic diseases than of softening of the brain, heart affections, albuminuria, general debility,—the outcome of worry and competition!

The Mason College Magazine. Edited by Students of Mason College, Birmingham. Vol. I., No. 1. January, 1883. Birmingham: Cornish Bros.

We have great pleasure in welcoming this young contemporary. It appears that about two years ago the students of the Mason Science College felt themselves led to form an association for social and intellectual intercourse. This society, now known as the "Mason College Union," seems to have led to the little magazine before us, in which its future proceedings will be duly reported. From the number before us we learn that "Professor Haycraft is completing a test for uric acid by which a quantitative analysis can be made in about fifteen minutes."

We were not aware that the plan of the Mason College included the study of classical literature. Such, however, it appears is the fact. We further learn that Prof. Bodington, who has filled the classical chair, has resigned it for the post of Principal and Professor of Classics at the Yorkshire College. This is an interesting fact. The Yorkshire College was originally founded for the study of Science alone. Then literature was added, and now already the office of Principal is committed to a Professor in that department! We fear that the emancipation of Science is not so near as the "poor humanist" seems to apprehend.

In the editorial introduction we note the just remark that—"The science of the philosopher is a very different thing from the science of the vulgar, which is nothing more or less than some form or other of art." Against this confusion, which is more rife in England than elsewhere, and in which public speakers and eminent writers freely indulge, we have protested all our life, but in vain.

One point in the proceedings of the College Union which we notice with scant satisfaction is the tendency to political debates. Thus we find among the proceedings of the year past a discussion on the abolition of an hereditary House of Lords; and in the course of last month (February, 1883) the subject for debate was that the prohibition of religious subjects from debate ought to be abolished. It is to be feared that political discussion will, in the Mason College as elsewhere, prove not favourable to the growth of profound and original thought.

Among the causes of that racial degeneracy against which Mr. Herbert Spencer has so earnestly cautioned the American people, Dr. G. Beard some time ago pointed out the "experiment of making every man, woman, and child a politician and a theologian."

We in this country have, for the last seven or eight years, especially suffered from an excess of political writing, speech-making, and discussion, and if we aim at an honourable place in the intellectual world we must turn our attention elsewhere.

The Mason College Magazine. Vol. I., No. 2, February, 1883.

THIS second issue of the "Mason College Magazine" is a decided improvement upon its predecessor, and makes us hopeful as regards its future.

The article on "Scientific Idealism," from the pen of Miss Constance C. W. Naden, is an exceedingly able and luminous exposition of a theory which seems to be forcing itself upon the attention of thinkers. We believe that the writer will leave her impress on the philosophical literature of the age, which, indeed, stands in some need of re-casting.

A humorous article on "Spelling" contains a discussion as to the correct spelling of "calligraphy" or "caligraphy," which is now sometimes in a spirit of vulgar affectation used as a synonym for hand-writing.

At a meeting of the "Mason College Union" a paper was read by Miss Evans on "Degeneration," which, it is announced, will be printed in a future number of the Magazine. We are glad to perceive that the proposal to introduce the discussion of religious subjects was rejected by a majority of more than five to one.

A sketch of the life of Joseph Priestley, by Mr. G. Harris Morris, though in brief compass, is exceedingly good. The author justly remarks that, "in spite of the numerous discoveries of Priestley, we cannot regard him as a scientific man in the true sense of the word. His discoveries were the result of haphazard experiments performed at odd moments, usually before breakfast, and he lacked the ability to properly interpret the results he obtained.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

"REDUCTIO AD ABSURDUM."

To the Editor of the Journal of Science.

SIR,—REGARDING the advanced scientific formula I send two syllogisms:—

> The Sun is the cause of all animate existence.
> Intelligence is the resulting fact of animate existence.
> Therefore—the Sun is the cause of intelligence.
>
> Intelligence is the factor of all things.
> The Sun being the cause of all animate existence.
> Therefore—the Sun is the maker of itself.

These syllogisms I send you by way of a nut for your correspondent, "A Lucretian," to crack. He seems apt enough to ask questions and suggest doubts (presumedly *à la Socrate*), and doubtless your readers would be glad if he would give them some of his reason and logic (*à la Platon*).

An apt observation (I think) of Lord Mahon's is in point:—"It is among men as among certain tribes of animals; it is sometimes only necessary that one of the herd should step forward and lead the way to make all the others follow with alacrity and submission.

A propos of this is the much-vexed question of "mind in animals." The real point is, What is meant by mind? There can be no question but that animals have intelligence. If they had not, unless merely *automata*, how could they exist and carry on their functions? That they have intelligence the most unobservant could not doubt; but it is mainly, if not entirely, directed to sense (sensation) results—to the gratification of appetite, preservation, affections and generation, and probably avoidance of pain. They have instincts and instinctive intelligence, which reaches the primitive stage of reasoning. All this they share with man. The mind of man is the aggregate of all that has gone before, to which is superadded the abstract powers of reasoning on things other than those of the senses. What animal, other than man, concentrates its intelligence in the contemplation of ultimate causes?—in the contemplation of the purposes of Creation (so to speak) and of a God?

On this question (animal intelligence) the most absolute absurdities are indulged in; *vide* "Nature," "Science Gossip," the ponderous volumes of Dr. Lauder Lindsay ("Mind in the Lower Animals"), and the latest production in this class of literature by the learned zoological secretary of the Linnean Society ("Animal Intelligence"). Mr. Romanes in this work (page 29) says, of limpets, "that after every browsing excursion they return to one particular spot or home, and the precise memory of direction and locality supplied by this fact seems to justify us in regarding these actions of the animal as of a nature unquestionably intelligent."!! It might just as well have been said that the creature eats to satisfy its hunger; *intelligent* because by eating it preserves its powers. At page 25, in the same work, he remarks on the *educated* oyster closing its shell to preserve it intact on reaching Paris. In another part of the same work (page I forget) this fact is claimed and commented on as a proof of intelligence!!! There are many other passages of a like character, and so strained is the reasoning that it suggests to the mind of the reader the dilemmas of a pressed advocate, and almost leads one to think that the author (with all his reputation) is unable to distinguish between a purely sense action and a mind action; but if, on the other hand, we are to conclude that *Sensation*, *Mental Power*, and *Vitality* are merely Sun results, then we may suppose that the mistiness which is so apparent is merely the effects of Sun vibrations. Lord Mahon seems to have anticipated our scientific theorisers.

In conclusion I would say that most of the scientific theorisations are strained and bizarre, and that their object appears to be that man and his intelligence should find class in the chapter of animal degradation (Lord Brougham, "Dialogues on Instinct," says something like this); and that man, in his most intellectual attribute, is merely a *trained ape*; and that there should be excised from the mind of man all idea of other potencies than Matter and Force; and that the conception of God should be banished from his intelligent and wonderfully designed Universe.—I am, &c.,

S. BILLING.

DESCENT.

To the Editor of the Journal of Science.

Sir,—How far has isolation operated on Descent? Would not the separation of one or a few pairs of individuals from the congregated species cause a more decided and rapid development of variations than if left with a large number of their own race?

There are many items possessed in general which, however, every individual does not unfailingly inherit, but this is speedily rectified in the offspring by reason of overwhelming opportunities. But if one pair were isolated the only influence at work would be contained in the parents; the vigour of their particular constitution would have full play, and their peculiarities would be inherited without any fear of counteraction by the generalities of the species, variations consequently arising much more rapidly.

There is no other explanation in domestic species, but may it not have taken place on a much more important scale? Hereditary fancies will no doubt help to keep up a species, though very often I have noticed pigeons decidedly prefer another variety to their own.—I am, &c.,

D. Y. C.

[Our correspondent's views seem essentially the same as those of Dr. Moritz Wagner, discussed in our last volume (p. 460) under the title "Evolution by Segregation."—Ed.]

THE COST OF SANITARY REFORMS.

To the Editor of the Journal of Science.

Sir,—On reading a recent article on "Health in Health Resorts," from the pen of Dr. B. W. Richardson, I am forcibly reminded that enthusiasts often forget to count the cost of their projects. We are told that it is possible to make use of water-carriage for sewage without having our rivers polluted. For this purpose the learned author would have "floating tanks on the canal or river, in or connected with a steam barge which should pump from the town its sewage into the receiving-tanks, and then, when charged, steam away with the fertilising material to depôts in the course of the river, where the material could be applied, directly or after precipitation, to the purposes of agriculture."

It may be instructive to examine what tonnage would be required thus to convey away the sewage of a large town situate on a navigable river. The daily dry-weather flow of sewage from the town in question is estimated at a minimum of 8,000,000 gallons = 80,000,000 lbs. weight, or, in round numbers, 35,000 tons. To convey this mass of liquid away we should require the constant service of 175 barges, each of 200 tons capacity, or from fourteen to fifteen every hour per working day of twelve hours. Let your readers imagine the outlay of building this fleet, and the daily working cost in wear and tear, interest, fuel, and wages, and then reflect that the ordinary expenses of the disposal of sewage, whether by irrigation or precipitation, would have to be superadded.—I am, &c.,

BEGGIATOA ALBA.

INFLUENCE OF WHITE OBJECTS.

To the Editor of the Journal of Science.

SIR,—Can any or your readers explain why a white cloth, a sheet of paper, or other white object, especially if in motion, has such a repulsive effect upon birds, wild or tame? Upon insects they seem to have a powerfully attractive influence, as anyone may observe who lays down a white cloth in a field or wood, and awaits the result.—I am, &c.,

P.

NOTES.

Some time ago M. Fouquet described an epidemic among young trout occasioned by *Ichthyophthirius multifilis*, a singular ciliated infusorial which lives parasitically on the epidermis of the trout, occasioning a fatal inflammation. M. Henneguy ("Comptes Rendus") has described another epidemic among young trout caused by a flagelliform infusorial which he assigns to the genus *Bodo*, and names *Bodo necator*. Unlike most of its tribe it cannot live in impure waters, but prefers the clear well-aërated water which is essential to the health of the trout.

M. Ch. Musset has observed in certain plants a phenomenon which he names Selenotropism. They bind and turn towards the moon in a clear night, just as they are known to incline to the sun by day.

H. Th. W. Engelmann ("Pflüger's Archiv.") has observed in *Bacterium photometricum* a well-developed sensibility for light and colour. It can even be used for testing the permeability of various bodies for the ultra-red rays. He considers that bacteria, though morphologically plants, are physiologically animals. He has observed that all parts of the human eye are transparent for the ultra-red rays, which therefore reach the retina without affecting it.

Prof. Berthelot maintains that the true element carbon is as yet unknown; that it must be of a gaseous nature; and that diamond, graphite, &c., are polymeres of the veritable carbon.

According to MM. Gerlach and Koch ("Biologisches Centralblatt"), if the shell of an egg is coated over in great part with varnish, the embryo is dwarfed, sometimes not reaching a fourth part of its normal size, whilst the head is disproportionately large.

Sir W. Hooker ("Pharm. Journal") states that the powdered capsules of *Puneeria coagulans*, a shrub common in Northern India, may be used in cheese-making in place of rennet. A decoction of 30 parts of the powder in 1150 parts of water is sufficient. A teaspoonful of this liquid is sufficient for a gallon of milk.

At the February meeting of the Entomological Society M. Perinier communicated an interesting paper on three species of *Paussus* found in ants' nests at the Cape of Good Hope. All crepitate like the Brachinidæ, emitting a yellowish matter, which stains the fingers yellow and cannot be removed for some days, in spite of washing. Their relation to the ants seems to be rather one of mutual tolerance than of actual benefit to either party. The ants drag them back if they approach recently-hatched larvæ. On such occasions they never crepitate, but if touched with a straw they discharge with great violence, and any ants in the neighbourhood appear as if stunned.

At the same meeting was exhibited a large green grasshopper, recently caught in a conservatory, but belonging to the African genus *Conocephalus*. Though belonging to a phytophagous group it was strictly carnivorous, devouring flies, spiders, and bits of raw beef. Its introduction into England is not explained.

At the meeting of the Entomological Society, March 7th, Mr. McLachlan, F.R.S., exhibited a living specimen of *Polistes hebræus*, an Indian wasp, which had found its way to London in a cargo of bamboo.

It appears that the prothoracic stigmata of the Elateridæ are provided with trap-doors, which close the entrance to the tracheæ.

According to "Ciel et Terre" the caterpillar of *Zerene pantaria*, which feeds on the ash tree, is not at all affected by temperatures of −30° to −40° C. Neither birds, ants, nor any other insectivorous creatures attack them. Wet weather is the greatest hindrance to their spread.

Yponomeuta cognatella, a social caterpillar, often occasions great damage in the apple-orchards of Normandy, sometimes ruining the entire crop.

M. R. Blanchard, in a memoir presented to the Academy of Sciences, maintains that the chromatophores of the Cephalopoda do not differ in their general structure from those of fishes, batrachians, and especially saurians. The surrounding tissues take no part in their movements.

With reference to the "Cruelty to Animals Bill" the "Medical Press and Circular" remarks—"It would afford us no surprise to learn that the majority of Mr. Jesse's supporters are indignantly averse to such restrictions on their playful amusements as in the near future will be imposed." (A very different, and we believe much more correct, view than that taken by Mr. Lawson Tait.)

Prof. Nordenskiöld intends visiting Greenland in August next, with the intention of penetrating into the unknown interior, which he believes cannot be permanently glaciated below 80° north latitude.

An Exhibition of Insects is to take place in July next, at the Palace of Industry, in Paris, under the auspices of the "Central Society of Agriculture and Insectology." (Insectology! a vile word.)

According to "Les Mondes" an Italian *savant* pronounced a specimen of gold submitted to him to be yellow mica, because "Science does not admit the possible occurrence of native gold in Eocene formations."

According to "l'Electricité" Fra Paolo Sarpi is said to have anticipated some of the results of Gilbert on magnetism.

We quote the following letter from "Light" (January 27th): —"Last evening I had been to see a sick friend, and left at ten o'clock. At about 10.30 I was passing a churchyard about two miles from the city, and noticed a light in the churchyard. As the gate was fastened I scaled the wall and walked towards the light, when it moved on, waving slightly, as a flame would. The light was of a phosphorescent colour, and was about 5 ft. in height and an irregular width of about 18 inches. It moved slowly across the graves with a sliding motion, in an easterly direction towards the wind, which showed it was not an *ignis fatuus*. It disappeared near a yew fence." (The circumstance of the light moving against the wind does not disprove that it was an *ignis fatuus*, except to persons who refer this phenomenon to a luminous gas. The season of the year, however, does not agree with the theory of phosphorescent insects.)

We learn from an esteemed medical contemporary that, in St. Pancras at least, undertakers play a prominent part in the Anti-Vaccination movement.

Dr. Cullen, of Kundwa, on examining 430 railway officials in India for colour-blindness, found among the half-breeds (Eurasians) 1·6 per cent, among Mahomedans 7·31 per cent, and among Hindus 3·16 per cent, suffering from this defect. Among 471 boys he found 2·54 per cent incapable of distinguishing colours, and among 68 girls none.

According to the experiments of Dr. Tarnier, as quoted by the "Medical Press" from an American journal, it is possible to produce giants to order. The child is kept in the dark, at the constant temperature of 85° F. It grows rapidly, and doubles its weight in about six weeks. It is asserted that six months of this treatment do as much for the development of a child as eight years of ordinary life!

The Scottish Educational Congress has passed the very sensible resolution that the present educational demands are calculated to be prejudicial to the health of children.

If the human will can produce effects without the intervention of bodily organs, why may not the will of other animals do likewise? Possibly we have here the explanation of the so-called fascination of serpents.

H. van Wielowiejski (" Zeitsch. Wissen. Zoologie ") has made a thorough anatomical and physiological study of the Lampyridæ. All the species examined have in their mature state a very imperfect development, containing organs otherwise peculiar to larvæ. The luminosity cannot have the object of sexual attraction, as it is shared by larvæ immediately on leaving the egg. The luminous organs are homologous with the fatty bodies in other insects.

Mr. W. B. Cooper (" American Naturalist ") makes some interesting suggestions on the possibility of teaching brutes the use of letters.

According to the " New Hampshire Gazette " a toad, having observed that flies were attracted by moistened meal which was given as food to a brood of chickens, contrived to roll himself in the saucer, and thus became a living and very efficient fly-trap.

The " American Naturalist " quotes, from an essay by the late Chauncy Wright, the following passage:—" According to Mr. Spencer's views the first strata, had they been preserved, would have contained the remains of Protozoa and Protophytes; but for aught we dare guess they might have contained the footprints of archangels." Our contemporary adds in comment:— " Truth is stranger than fiction. What else can be the Carson foot-prints?"

Prof. Mallet, in an official report on the chief processes used in the chemical analysis of drinking water, concludes that " it is not possible to decide as to the sanitary quality of a water by the mere use of a process for the estimation of organic matter and its constituents."

The spider crab of Japan (*Macrocheira Camperi*) has been known to reach the lengths of 10, 11, and even 15 feet.

ERRATUM

Page 86, line 13, for *Pinchœta* read *Perichœta*.

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THE

JOURNAL OF SCIENCE.

MAY, 1883.

I. FLANK ATTACKS ON EVOLUTION.*

MR. RUSKIN'S noted treatise on the management of sheepfolds is not the only work bearing a title which throws no light upon the nature of the contents or the purposes of the author. The two essays before us might indeed have legitimately claimed our attention, but we should have little suspected at first sight that both of them are attempts to obtain a reversal of the great intellectual reformation of the nineteenth century.

The distinctions between crystals and organisms are, no less than their mutual analogies, a fair subject for investigation. But we scarcely see that Mr. Howard has thrown any new light upon this interesting question. It has long been known that crystals consist of a multitude of particles similar in shape, in structure, and in composition to the whole which they constitute. It is admitted that a crystal, though it may grow, is incapable of true ingestion and excretion; that it does not propagate its species, and that it has no vital cycle. There is indeed in the crystal, as in the organism, individuation; a certain portion of matter, more or less complex, is marked off from all around it. It may further be contended that a crystal can grow under suitable circumstances, and that if damaged it possesses a self-reparative or restorative power. We may also be told that the distinction between growth and reproduction is not so capital as was once supposed; and again, that there are animals having no definite vital cycle, which are not born, and which do not of necessity die.* It may likewise be shown that in lowly animal forms there occur structures not curvilinear in their outlines, but reminding us of the geometrical forms of crystals. It is also indisputable that in the diamond, a crystal formed of carbon,—the characteristic organic element,—curvature is at least foreshadowed. Still, granting all these approximations, or rather perhaps analogies, there is a gap between life and crystallisation not easily to be filled up. We can take amorphous, shapeless matter, quite devoid of individuality, and by very simple manipulations we can cause it to crystallise in forms differing according to its chemical nature. But so far, it must be frankly conceded, we have been unable to start life afresh. We must have the ovum, the seed, the spore as an initial-point. We cannot take animal or vegetable matter, as obtained from dead animals or plants, and from it construct even the humblest living organism. Still less can we vivify inorganic matter. And unless we can perform this latter exploit, all the experiments of a Pouchet or a Bastian, even if free from the slightest loophole for error, are, *ex hypothesi*, beside the real question.

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* The Contrast between Crystallisation and Life. By J. E. HOWARD, F.R.S., F.L.S., F.R.M.S., &c. London: E. Stanford.

Le Nouveau Programme de l'Enseignment Secondaire. Par M. H. DE CASAMAJOR. (*Les Mondes*, March 4, 1883.)

But admitting all this, provisionally at least, we have to ask whether the contrast between crystallisation and life has the signification which Mr. Howard and his friends seem to find in it, and whether it can be accepted as an argument of any weight against the truth of Evolution?

It may well be questioned whether any upholder of the doctrine of Development regards crystals as a stepping-stone —much less a bridge—between dead, unindividualised matter and the plant or the animal, or assumes organisms as having arisen from crystals. Lorenz Oken, more than forty years ago, taught that the crystal sprang from the fluid drop by a process of contraction, flattening down, whilst the organism took its departure by the opposite process of expansion. Translated into more modern language this means that the crystal and the organism do not stand on the same ascending line, and that contrasts between them are hence naturally to be expected.

As for the origin of life we must seek deeper. It may perhaps yet be found, though, considering the vast complexity of the humblest organism as compared with the crystal, it may possibly for ever elude human search. But taking the worst case: supposing that life took its rise, as

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* Journal of Science, 1882, p. 401.

Darwin admits, in the manner commonly called miraculous, is that any reason that we should adopt the theory of mechanical, individual creation? There are writers who contend that if the origin of the first living being demanded a breach of the law of continuity, a direct Divine interference, every animal and vegetable form may have taken its origin in the like manner. To this argument we oppose the "principle of parsimony," which bids us not invoke a "*Deus ex machina*" where it is not absolutely imperative. We see, further, if we are able and willing to weigh fairly the evidence, that God did not mould every plant and animal on the "contract" principle of the Old School, but allowed them to be evolved by "descent with modification" from anterior forms of life.

We have now to notice a portion of Mr. Howard's pamphlet which we would gladly pass over were if not essential for an understanding of his position and his *animus*. We refer to the manner in which he, in his attack upon Evolutionism, drags in Auguste Comte and Positivism. He writes in his "Conclusion":—"There is an irreconcilable opposition, a total contrariety, between this doctrine [*i.e.*, 'that life is a gift of the Almighty'] and the religion of M. Comte which would wholly subvert the existing order of things. The adherents of Positivism and the disciples of Darwin are sufficiently outspoken on these subjects." He quotes, in a note, the "Gazette des Tribunaux" for March 2nd, 1870, describing Comte's repudiation and desertion of his lawful wife, who had been his faithful companion and nurse during an attack of insanity, and his—to us—disgusting *liaison* with Clotilde de Vaux, the wife of a convict.

Now supposing any of those "average English minds" whose "impracticably practical character," "strong common sense,"* and "attachment to cherished traditional opinions" the author has vaunted, reads and considers the matter we have just quoted. Will he not, finding Comte and Positivism suddenly introduced in so unfavourable a light in the peroration of an attack upon Evolutionism, be led to suppose that the two doctrines are closely allied, and that Comte was probably a forerunner and fellow-labourer of Charles Darwin? Now we are not at liberty to assume that Mr. Howard wished or intended that his readers should fall into this mistake. Yet he has certainly taken no pains to save them from so gross an error. Personally he must know—at least we cannot insult him by the contrary supposition—that Auguste Comte was an upholder, even as Cuvier, Agassiz, or Dawson, of the permanent distinctness of organic species; he must know that, with perhaps the single exception of George Henry Lewes, the Positivists, with their present leader Robin, take the same view, and condemn Darwinism in language sufficiently vigorous. Many of Mr. Howard's hearers must also have been fully aware of the fundamental opposition—the difference *toto cœlo*—between Evolutionism and Positivism, between Darwin and Comte. Yet none of them, as it appears, in the subsequent discussion had the candour to point out the misconception to which the speaker's words might give occasion. They allowed, tacitly at least, the moral shortcomings of Comte to prejudice the public against the doctrine of Evolution.

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* This is a thing of the past. The Englishman of the present day has small claims either to practicality or common sense, and is, of all civilised nations, the most easily thrown into a state of panic and stampedo.

We have, of course, no wish to defend either Comte or his followers. We regard them as enemies to Science, especially as regards physiological experimentation, and we are anxious merely that their full antagonism to Evolutionism should be clearly recognised. At the same time it may, perhaps, be questioned in how far an exposure of the moral errors and shortcomings of any writer may legitimately be used for the refutation of his theories? It may further be denied that Evolutionism is or can be, if rightly interpreted, "subversive of the existing order of things." That order, from the very fact of its existence, must be in some degree in accordance with man's nature and with his surroundings. Those who believe in catastrophism, in sudden destructions of all living, and in re-creation, may aim at revolutions in matters social and political, but the consistent Evolutionist can indulge in no such aberrations.

M. de Casamajor introduces his attack on the New Natural History in a somewhat different form. He entertains fears that "the Christian family is attacked; that Episcopacy, the Councils, and the Pope are calumniated"; and hence he wraps up his onslaught on Evolutionism in a series of essays on higher education. He, like M. l'Abbé Moigno, proposes to "become offensive." In what sense he succeeds in so doing may be judged from the following passage:—

"XI. Darwinism supposes two impossible facts. 1. Life derived from brute matter. 2. The existence and growth of a being cast naked and feeble upon the earth."

"1. Life does not spring from blind matter. If in fact the inherent forces of matter, or chance, have been already able to form organised beings, why in our days do we not see in the air, in the ocean, on the mountains or the plains, the sudden appearance of a living creature the origin of which could be with certainty attributed to inorganic matter?

"2. And how, deprived of maternal cares, could a young animal subsist without experience and strength?

"How could the young sparrow, when commencing to live, preserve its existence if its parents did not bring it regularly either the insects or the seeds and the fruits necessary for its support?

"I see it, this frail and delicate creature: it succumbs after true sufferings caused by cruel hunger. If the mother does not keep the young swallow warm it must soon perish under the influence of cold; its eyes contemplate the light, and darkness then infolds them; life with a red blood circulates in its veins, in its arteries, and the icy hand of death soon stops it; its brain and nerves had placed it in connection with the external world, but deprived of their exquisite sensibility they cease to perceive the radiance of the sun and sounds full of harmony.

"No! a creature at the outset of its existence cannot be thrown *feeble and naked* upon the earth, and still preserve there its life.

"There was required, at first, for every species, a being completely formed, a being whose body, instincts or reason were entirely developped; parents were necessary created in their adult age.

"Darwinists *admit* consequently as true, as a fundamental principle of their theory, an *impossible fact*."

We have transcribed literally this passage from our "offensive" author lest we should be suspected of wickedly perverting his line of argument in order to make him appear ridiculous. Few persons, indeed, would be able to conceive that a man of any education could seriously put forward such a misconception, not to say misrepresentation, of Evolutionist doctrines.

It is no part of the teachings of Darwin—as M. de Casamajor might see from the concluding passage of the "Origin of Species"—that life sprang originally from "blind matter." Nor is such an assumption in the least necessary for the validity of the Evolutionist theory of the organic world. We may even go a step further, and ask how does M. de Casamajor know whether or no in our days a living creature, previously unknown, has or has not ever suddenly made its appearance? How would he distinguish between such a creature and one which might have existed for thousands of years, but had hitherto escaped observation? Darwin supposes—whether rightly or wrongly is for the moment immaterial—that new forms do not "suddenly" appear, but are the outcome of cumulative changes, each step so minute as to escape observation.

Turn we to the second difficulty which M. de Casamajor encounters—the question how a young animal, devoid of experience and strength, could exist without maternal care? This seeming "impossible fact" is got over to the present day in perhaps the majority of animal species. Many reptiles and amphibia, most fishes, the majority of insects and mollusks, not to speak of lower forms of life, deposit their eggs and leave them to the tender mercies of the world. Such an egg receives and requires no more parental care than does the spore of a fern. Darwinism does not suppose the production of any but the very lowest forms of life except by mature parents. And amongst the Protozoa we find propagation without the slightest approach to the relations of parent and offspring.

Darwinism, in short, does not suppose the two impossible facts which M. de Casamajor is pleased to rank amongst its fundamental doctrines. Is it any transgression against courtesy if we, on our part, express the wish that before condemning Evolutionism as he does, he would at least make himself accurately acquainted with its peculiar tenets, and not ascribe to it *Hirngespinste* of his own. Might we not remind him of the desirability of making himself better acquainted with the conditions of animal life, and thus escape the error of declaring that "every species" requires in infancy the fostering care of parents?

We will now venture to assume "the offensive," and to enquire into the necessary results of the origin of animals, if it had taken place in the manner recognised by traditions and by the Old School of Natural History. Let us suppose that a pair of every animal species has been suddenly and specially created within the interval of (say) two or three literal days, and set at liberty to seek its sustenance: how will such sustenance be found? Everyone who has even a popular acquaintance with animal life is aware that multitudes of species subsist only upon the refuse and the *débris* of pre-existing animal or vegetable life. We have in most of the great groups carrion-feeders and devourers of excrement. The bones, the flesh, even the wool, the hair, the feathers, horns, and hoofs of defunct vertebrates furnish support to the hyænas and the dog tribe, to the vultures and the crows, to fishes too numerous to enumerate, to carrion and dung-flies, to moths of the group Tineidæ, to the necrophagous beetles, the Sphæridiidæ, the Staphylinidæ, the coprophagous Lamellicorns, and other groups which it would be equally needless and tedious to mention. We have then the parasitic groups, entozoic and epizoic, to be provided for.

In like manner the refuse of the vegetable world—wood, leaves, &c., in various states of decay, furnishes a pabulum for a host of beetles, myriapods, certain lepidopterous larvæ, for the land-snails, and even for the earth-worms, whose diet consists largely of humus. It may well be asked how, on the mechanical creation theory, could all the above enumerated groups find support save on the assumption of a perfect complication of miracles? We have heard it suggested, by an adherent of "brachy-chronology," that the fossils, animal and vegetable, which we discover in the earth's crust are not the remains of extinct species, but mere *simulacra* "for man's illusion given." Are we, in the same spirit, to assume that this earth was created ready stocked with carrion and excrement, with decayed wood and withered leaves?

How beautifully simple, on the other hand, is the Evolutionist view which supposes that, as any kind of refuse matter became abundant, some animal form, impelled by the struggle for existence, adopted such refuse, first as a portion of its diet, and then as the whole, its habits and its structure becoming modified accordingly. On the mechanical-creation hypothesis the eater would in many cases precede its food, whilst on the Evolutionist hypothesis the food would precede the eater, which would take advantage of the new opening.

Both the writers whose views we have been discussing approach Evolutionism from an ecclesiastical point of view, and both seem to regard it as hostile to and irreconcilable with Christianity. Says Mr. Howard, in the opening passage of his pamphlet, "It has been supposed that the notion of Deity, or of an omnipotent creative and sustaining power, may be thus removed to a greater distance from the human mind; and the unwelcome thought of responsibility to a higher tribunal than those of earth, and of subjection to an eternal judgment abolished." Here is a distinct, a grave, and we hesitate not to say an utterly baseless, imputation. Mr. Howard here insinuates, if he does not directly assert, that the motives of Darwin and of his coadjutors and disciples have not been scientific, or at least not purely so, but that they have been actuated by other considerations—by a hostility to revealed religion. Now there is no evidence whatever in support of this charge. The true man of Science does not go forth in search of the extra-scientific bearings of his conclusions. Darwin, as far as we know, had simply in view to display the phenomena of the organic world in a form worthy to be called scientific. Some of his disciples, as well as not a few of his opponents, are heterodox; but that they are heterodox because Evolutionists is simply a railing accusation. Mr. Howard would do well to reflect that Mr. Wallace, Prof. St. George Mivart, Dr. Drysdale, Dr. Dallinger, and numbers of leading Evolutionists both in this country and especially in America, repudiate Atheism as distinctly as does the "Victoria Institute."

It may perhaps be contended that Mr. Howard is not speaking of Evolutionists in the passage which we have quoted. Let us therefore look further. He writes:—"It might almost be said that they [the prophets and teachers of this new doctrine] form a mutually supporting and a somewhat exclusive sect. . . . It is not the present generation of Englishmen who will be reconciled to the thought that they are in their origin viler than the sea-weed, and in their gradual fashioning improved out of the most lowly organised animals that the earth and the sea support."

Lest this should not seem sufficiently decisive, the author refers to and quotes in his Appendix a passage from the "Edinburgh Review" of April, 1873. It runs:—"The practical influence of the new doctrine is seen in the rise and rapid growth of a pseudo-scientific sect—the sect of the Darwinian Evolutionists. This sect is largely recruited from the crowd of facile minds ever ready to follow the newest fashion in Art or Science, in social or religious life, as accidents of association or influence may determine. . . . The evidence in favour of the central Darwinian doctrine is notoriously deficient, but this is no hindrance to its enthusiastic acceptance. . . . Another note of sectarianism is their tendency to intolerance. The tendency is manifested, perhaps, in its extremest form amongst the rank and file of the sect. It displays itself, however, in various shapes, some of which are amusing enough. This tendency to intolerance appears also in the writings of the school, especially in the less distinguished. The tone of the discussion in many cases involves the tacit assumption that the Evolutionists are the only wise men, and that wisdom itself will die with them." Who is the writer quoted we know not. For anything that appears to the contrary he may be some *litterateur*, unwilling and perhaps unable to weigh the evidence in favour of Evolution with the patience which it demands. The "sect," as he calls it, has secured the adhesion of the great majority of working naturalists, and finds its opponents chiefly among those who know it by hearsay or by dipping into the "Origin of Species." The charge of intolerance comes with a singularly bad grace. We know of no Evolutionist writer, even the "less distinguished," who has sought to rival the adherents of the Old School in the use of offensive language, in appeals to passion and prejudice, in misrepresentation, or in personalities. Every year that passes seems but to strengthen the evidence in favour of Evolutionism, and to win for it more general acceptance among patient searchers for the truth.

II. PATENT RIGHT AND PATENT-LAW.*

By An Old Technologist.

THE question of patent-right and copy-right is at present in a most unsatisfactory condition. Experts, or persons who at least profess themselves such, differ not merely as to details and points of expediency, but as to first principles.

We cannot even agree whether a Patent is the registration of an inventor's property in his own ideas, or the grant of an especial privilege which the State may confer, but which is still a phase of "monopoly" and a sin against our modern English deity, "free trade." To me it seems that in this discussion the ideas of monopoly, protection, and free trade are essentially foreign. If any property is to be held sacred, surely that of a man in the creation of his own brains must hold that position. A new book or a new invention is something which heretofore had no existence. The author or the inventor has not appropriated to his private and exclusive use something which previous was common and open to the public. He has not limited the scope and the field for the exertions and the enterprise of other men; on the contrary, he has in many cases opened out new tracks. In what legitimate sense his claims can be called a privilege and a monopoly I do not see. According to Coke's definition a monopoly is a grant or decree of the ruling power, by which some person, company, or corporation is invested with the exclusive right to manufacture or sell certain goods, or to perform other actions which were previously open to the public in general.

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* The Government Patent Bill of 1883.

The Patent Bills of 1883: Private Aims and Public Claims. By R. A. Macfie, F.R.S.E. Edinburgh: T. and T. Clark.

Copyright and Patents for Inventions. Vol. II. By R. A. Macfie. Edinburgh: T. and T. Clark.

To take an instance: the East India Company was formerly endowed with the exclusive privilege to trade to India, China, and in general to countries situate eastwards of the Cape of Good Hope. This was evidently a monopoly, because previous to their charter any British merchant might, if so disposed, trade to those countries, and was afterwards prevented from so doing. On the other hand, suppose John Tomkins invents a dichroic dye, which when applied to silks gives them a beautiful rose colour when seen in one direction, and an intense green when viewed in another. He applies for and obtains a patent. But the exclusive right which he thus holds deprives the public of nothing, since prior to the invention of John Tomkins they could not make this dye.

Even Mr. Macfie, who can scarcely be accused of too strong a bias in favour of the rights of inventors, says, in his evidence before the Commons' Committee in 1871, very much the same thing:—"They are not deprived of anything that they had before. Patents do not deprive you of any rights. The theory is that a Patent creates something that did not exist before. With regard to the old monopoly it was a grant of something in existence, such as the sale of sugar or salt; in fact there was hardly anything that was not a subject of monopoly in the old times, and there the public were deprived of something." It is surely therefore to be regretted that such terms as "protection" should still be retained, and that reference is still made to the "Statute of Monopolies." These very words at once throw free-trade champions into a state bordering on *delirium tremens*, and make them fancy that they have, as such, a good *locus standi* in the discussion of the question.

But it is asked by the opponents of copy-right and patent-right, why, if there can be property in ideas, are not the author and the inventor secured in the enjoyment of their rights for ever, instead of for a limited term? This is a very difficult question to deal with. In the German empire copy-right is, I believe, perpetual. It is to be considered that the value of a book or an invention is greatest immediately after it has come into notice, and in the course of a century becomes, in all ordinary cases, almost null. Thus if a perpetual property were granted the author or inventor, or his assignees, might very probably in course of time abandon their rights. But we must also remember that not merely property in ideas, but property of other kinds, is in these days called somewhat rudely in question. The Communard and the Sans Culotte, unwilling or unable perhaps to work and to accumulate, inveigh against the landholder and the capitalist as monopolists. In the very same spirit the man, rich or poor, who can invent nothing cries out against Patent-right because it prevents him from appropriating his neighbour's ideas without payment. He longs for the abolition of Patent-law just as do his brethren above mentioned for the confiscation of real property, the seizure of the "unearned increment," and similar drastic measures which cannot here be discussed. It is admitted that the limitation of copyright and patent-right may seem to imply that they partake rather of the nature of a privilege than of property. But it will not fail to be noted that ordinary property is being subjected to increasing limitations. Among these rank the succession-, probate-, and legacy-duties, which on every occasion of a transfer greatly curtail its amount, if not its duration.

It must also be remembered that we in England, unlike other nations, grant perpetual monopolies to persons who do not originate anything, but who do merely what any other man or association of men might have done just as well. Suppose a number of capitalists club together, and propose to supply any town or district with water. It is plain that here is no novelty, invention, or improvement. The methods of collecting and storing water in reservoirs, of conveying it in mains, and of distributing it in service-pipes are as well known as is the art of building a house. Yet on their application the Legislature will grant them a perpetual property not merely in their erections, tanks, culverts, and other works, but in the exclusive right to supply the town in question with water. If the inhabitants, weary of the extortions and malversations of such a company, wish to take the matter into their own hands, they cannot erect other waterworks in opposition, but must buy off or "compensate" the company. Why should we give the inventor so much more unfavourable terms than we grant to the speculator and the projector?

But leaving the consideration of abstract right, which I hold to be decidedly in favour of the inventor, let us turn to the question of expediency. Is the recognition of the inventor's property in his ideas beneficial or otherwise to the nation? Are the interests of the patentee and those of the public in harmony or in opposition? It will be of course admitted that, to hold our position as a great industrial community, we stand in continual need of improvements. We must make our goods either cheaper or better than we did before, and we must from time to time begin to make something new,—something which has not been made before. In a word we need invention: what is the best article to-day is no longer in the same position to-morrow; what suits present wants will not always meet the requirements of the future. If we stand still, our enemies—I use the term advisedly, for international competition is only a modern phase of war—will not follow our example, and we shall be left behind. We must therefore have a constant supply of inventions. For this purpose we must make it remunerative to invent. Few persons in this world will work persistently for nothing. It has indeed been cynically said, by some one of the talkers and writers whom Mr. Macfie delights to quote, that the inventor can no more help inventing than a hen can help laying eggs. Granting this provisionally, though egg-laying and inventing may be and often are stopped by sheer starvation, the hen may "lay away," and the inventor may go to some country which will register his property in his invention on more favourable terms than England offers,—which will give him longer security for a lower charge, and without the chances of lapsing. This is actually taking place. Some of the opponents of Patent-right say, again, that we can well spare those who leave us! Is this reason or infatuation? Further, the more difficulties we throw in the way of the inventor the fewer persons will aim at any improvements in arts and manufactures.

Would it not be better for the nation at large, and for themselves, if our working men sought to raise themselves by inventions rather than as at present by trades-unionism and strikes? But if we concede so much, what must we say of the policy of placing it substantially beyond the power of a working man of average position to obtain, and still more to maintain, a Patent? America acts on the opposite principle, and profits thereby. Many workmen there are busy with inventions and improvements who under our Patent-law, or if under no Patent-law at all, would become idlers or demagogues. Germany saw that many of her best men went to other countries where an efficient Patent-law prevailed, and introduced their inventions there.

To prevent this loss she enacted a Patent-law in some respects more liberal than that of England, and since then her inventors remain at home. They take out English Patents, doubtless, but they are very careful not to work them in this country.

We are trying to give our artisans a sound technological training, that they may be able to understand the principles of their respective trades, and be able to effect improvements. But all this is idle so long as we give the educated artisan no inducement to use his trained intelligence. A good Patent-law creates good industrial education.

The case stands thus :—

Without improvement no trade.
Without invention no improvements.
Without Patent-right no inventions.

I know it has been said that an inventor may work his invention as a secret process without seeking the protection of the Patent-laws. This method is one which in certain cases I have recommended to persons who have sought my advice. But it is practicable only (1) when the inventor is actually engaged in the business concerned, or is at least a capitalist ; (2) when the invention does not require very bulky and conspicuous plant, or the presence of a great number of workmen. I should have little faith in the possibility of keeping secret a new process for the manufacture of alkali, bleaching-lime, &c. New dyes, pigments, &c., may be manufactured successfully on the secret system, though everyone conversant with chemical industry cannot fail to note that the German manufacturers of artificial colours invariably patent their processes. They have, it would seem, little faith in secret working.

It is said that an inventor may succeed in disposing of a process for a fair value without the formality of a Patent. I doubt it : the would-be or might-be purchaser generally declines to buy a cat in a bag. He demands not only to see a sample of the article, but to be informed, before the completion of the bargain, as to the working details of the process. When matters are come to this point he is bound merely by honour. If this sentiment is weak, as is sometimes the case among the moneyed interest, he may break off the negotiation by saying "After all I do not see that the affair will suit my purpose," and may then begin the manufacture forthwith ! This is no mere supposition, as several cases have come under my personal observation where an inventor has thus been defrauded. Indeed I have only met with one instance where an alleged invention has been sold for a good round sum of money without having been previously patented. In this case I fear that the purchaser was the unfortunate party, since the secret—if there is any truth in the history of chemistry—was perfectly known to the Egyptians in the days of Moses!

Mr. Macfie is reported to have mentioned, not long ago, as one of the objections to cheap Patents, that they would enable a working man who came upon any improvement to secure it for himself instead of handing it over to his employer!

Perhaps it would not be unreasonable if those eminent men, economists, members of the chambers of commerce, and others, who entertain such strong objections to Patent-right, would point out some other feasible way in which an inventor might obtain at any rate some little remuneration for his trouble. To sum up this part of the subject, my conviction is that the interests of the public and of the *bona fide* inventor are substantially at one.

Still I am very far from conceiving that the matter is free from difficulties. Among the objections raised by Mr. Macfie, and by the public characters whose evidence he quotes against the working of our present Patent-laws, and indeed against any Patent-law, there are some which cannot be justly ignored, and in many cases—let our law-makers do their best—there will remain but a choice of evils.

I take it for granted that the original object or purpose for which a property in inventions was recognised was the introduction of new arts and manufactures into the country, or the improvement of such as already existed. To this end Patents were granted not merely for inventions originating in the United Kingdom, but for such as were imported from abroad. Such importation might be effected in two ways: either a British subject when travelling might observe the particulars of some improvement, and introduce it into this country on his return, or an alien, resident abroad, might communicate an invention to some resident in Britain. But in any case the end was the introduction of a new manufacture into the country. Now, partly in consequence of the defective state of the Law and partly from the rulings of the Courts, there has crept in, as regards these "communications from abroad," a complete departure from the original intendment of the Patent-system. The following cases are quite common: an alien, in possession of an invention which he either has patented or intends to patent in his own country, comes over for a time to this country, and obtains a British Patent; or the alien aforesaid instructs a British Patent agent to apply for a Patent as a "communication from abroad." In neither case has the alien in question even the remotest intention of working the Patent granted him in the United Kingdom. His object is the very opposite,—to prevent it from being so worked. Hence if any English manufacturer applies for a license under the Patent he meets either with a direct refusal or receives the offer of terms which are practically prohibitive.

Referring to this abuse—for such I must venture to call it—the Society of Chemical Industry writes:—"There are at this moment numerous Patents for the obtaining of artificial colours, which Patents are held by large Continental manufacturers, who, not being compelled to grant licenses, continue to send their products into this country, and thus prevent their manufacture here."

There is a closely analogous case mentioned by the same Society, which may not ever have actually occurred, but which is still possible, and against which we ought to beware in time. An Englishman, holding a British Patent for any invention, might, if so disposed, remove his establishment to some foreign country in which he had also obtained a Patent, or in which Patent-right does not exist, and thus inflict great injury on his own country. Says the Society of Chemical Industry:—"We would suggest that if Neison, who obtained a Patent for applying hot instead of cold air to blast-furnaces, had formed a company with the object of monopolising the whole of the iron trade, he could, if he had been specially interested in Continental coal and iron mines, have annihilated the immense capital at that time embarked in that industry in this country, and might have ruined large and important manufacturing districts."

Against these two evils, the former of which is actual and increasing, whilst the latter is by no means improbable, some precautions have been suggested. In the three abortive Bills for Patent Law Amendment which were brought forward under the administration of Lord Beaconsfield it was proposed that any Patent should become void if the patentee did not succeed in bringing it into use, on a practical scale, before the expiry of the third year. This proviso was much too sweeping. An inventor who is not at the same time a capitalist rarely succeeds in getting his invention taken up so early as the third year. Manufacturers hold back intentionally, in the hope that he may be unable to raise the £50 required for the third year's stamp-duty, and may thus forfeit his rights. Were it known that such a Patent would be inevitably forfeited unless in full action within this short term, the present reluctance to come to terms with the patentee would be very much strengthened. But the following stipulation might form part and parcel of our Patent-law :—" That if any person holding a Patent for the United Kingdom and for some foreign country shall work the said Patent abroad, but shall refuse either to work the same on a practical scale in the United Kingdom or to grant licenses to others on equitable terms, the Patent-right of such person shall lapse accordingly." This clause would, I think, effectually bar the door against the abuses to which the Society of Chemical Industry has so opportunely called attention.

It may be urged that foreign powers would in retaliation refuse to grant Patents to British inventors. I reply—Some States, such as Austria, France, and Belgium, already require as an essential condition for the maintenance of a Patent that it shall be worked within their respective territories. In other cases such a retaliatory movement might be met by treating any article patented in the United Kingdom but made abroad as contraband.

An objection has been widely raised against our present system of granting Patents to all applicants without any examination as to their novelty. This evil undeniably exists. Over and over again I have met with Patents claiming anew, and sometimes, *totidem verbis*, what has been previously claimed in older Patents, whether lapsed or still valid. French inventors seem to me particularly liable to fall into this error. Such re-patenting should certainly be brought to an end. To grant such a Patent is unjust to the second applicant, and, under certain circumstances, still more unjust to the public. The judges unfortunately, perhaps from their limited acquaintance with technical questions, show a certain degree of timidity in dealing with such re-patenters, who are thus sometimes enabled to blackmail the manufacturers for working a process which has long been in reality public property. It is satisfactory that the Patent Bill of the present Government proposes to submit all applications for Patents to the scrutiny of examiners better qualified for the task than the law-advisers of the Crown.

A defect in the present law is that Patents are granted for medicines, for articles of food and drink, and substitutes for such articles. An open door is thus provided by the State for quackery, for fraud, and adulteration. It has been suggested that were these articles, as in Germany, excluded from the protection of the Patent-law, and if the proprietors were debarred from bringing suits for libel, slander, or defamation, in reply to criticisms on their products, quackery in many of its forms would be swept from the country. But on this subject the Government Bill is dumb.

With chemical Patents there is a special difficulty. Shall new chemical compounds be patentable in themselves, or merely the processes by which they have been obtained in any particular case? The German Patent-system takes the latter view, holding, rightly enough, that some better, cheaper, or otherwise preferable method of obtaining any new compound may be discovered. If the compound itself is patentable, the public would be deprived of the benefit of such future discoveries. It must, however, be noted that many of the chemical manufacturers of Germany are by no means satisfied with this restriction. On the other hand, it is an unedifying spectacle, when a Patent has been taken out, to see claims for obtaining the same article, by means of agents, simply equivalent to those specified in the original Patent. Of this there was a typical instance in the many Patents obtained for the manufacture of magenta. On this point the new Bill is also silent.

It is possible that the proposed examination of the specifications and claims of all new applications may put an end to what are called "fishing" or "trailing" claims. Some inventors, whether from a natural turbidity of thought or from a desire to reap what they have not sown, draw their claims in such a vague manner as to be incomprehensible. Nowhere in a legal or business document is absolute clearness more necessary than in a Patent-specification. Any person conversant with the branch of manufactures in question should be able to see, without the shadow of a doubt, what is claimed and what is left open. I trust that the knowledge of the official scrutiny to be passed will cause both inventors and their Patent-agents to be more careful as to the language they employ.

If we get rid, for the future, of all Patents which are in whole or in part merely a re-claiming of what is already public property,—of all patents held by aliens, and not worked in this country,—of all "fishing" claims designed to entangle future inventors, and of the class of "quantum valeat" or "bogus" Patents, it will be the better for the genuine inventor, and Mr. Macfie and those who think with him will find many of their scruples removed.

Space being available, I hope to return to the consideration of this subject.

III. DARKER SHADOWS: A SOCIOLOGICAL STUDY.*

By E. S.

[We cannot allow the following article to appear without a prefatory tribute to our departed friend and contributor, Dr. G. M. Beard. Differing from him—and agreeing to differ—on points neither few nor trifling, we always found in his writings subjects for grave, and we trust not unprofitable, reflection. He was one of that rare class of thinkers who discuss matters to which the world is glad to close its eyes, and who dare to utter their thoughts. Few men would, like to him, have ventured to tell the American people that Guiteau was not a criminal to be punished, but an irresponsible lunatic to be placed in safe keeping. Fewer still would have presumed to say that America, and to some extent the whole civilised world, in seeking to make every man, woman, and child an expert in politics, is sapping the very vitality of the human race. George Beard was a man whom we could ill afford to lose, and whose early death we bitterly regret.—The Editor.]

DARKER shadows? Two months ago it was my lot to point out an ethnological phenomenon boding evil for the great English-speaking community across the Atlantic. It is now my yet more unpleasant task to discuss a calamity which has already begun, and which affects America, Britain, and all civilised portions of the earth, almost exactly in proportion to their civilisation.

There are few educated persons who have not read, in part at least, the memorable speech delivered by Mr. Herbert Spencer at the close of his visit to the United States. Few, however, are aware how closely this startling oration approached in its leading views the teachings of the late Dr. G. M. Beard. The last work of the distinguished neurologist whom we have so lately lost pointed out these approaches as a singular coincidence. It contains, in parallel columns, passages taken from Mr. Spencer's speech and extracts from

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* Herbert Spencer on American Nervousness: a Scientific Coincidence. By G. M. Beard, A.M., M.D. New York: G. P. Putnam's Sons.

Dr. Beard's treatise on "American Nervousness," as published in 1881, and no one who glances over the two can fail to be struck with the general sameness not merely of the thoughts, but even of the expressions. Thus Mr. Spencer declares:—"In brief, I may say we have had somewhat too much of the 'gospel of work.' It is time to preach the gospel of relaxation." In juxtaposition we read from Dr. Beard's treatise:—"The gospel of work must make way for the gospel of rest." These two passages give, in either case, the key-note to what follows. Dr. Beard raises the question whether there is here unconscious appropriation on the part of Mr. Spencer, or whether both writers have borrowed from some common sources? He comes to no definite conclusion. It is no part of my duties to complete what he has left incomplete, and either to condemn or to absolve Mr. Spencer of unacknowledged appropriation of the thoughts of others. My concern is rather with the ideas than with their original source. Certainly if two writers, proceeding independently and by different methods, have arrived at conclusions substantially identical, these may, on that very account, claim the more respectful attention.

Mr. Spencer and Dr. Beard admit, in the main, that modern civilisation is a gigantic failure. The ancient civilisation, based upon a military organisation of society, we know wore itself away, and is incapable of revival. Still whilst it lasted it was in a great measure successful. The Roman was trained, both positively and negatively, for war, conquest, command, and organisation, and in these directions he proved unmatched for centuries, till he practically renounced the principles by which he had been guided.

The modern man, of Europe and America, has been trained with ever-increasing exclusiveness for getting and having, and for work in a limited sense of the word, as the means to such end. To use phrenological language, acquisitiveness has for the last four or five centuries taken the place occupied by combativeness in the days of classical antiquity and in the Middle Ages. What has been the result? It is by no means pleasing to contemplate. The resources at the command of man have been, indeed, almost indefinitely increased. A variety of treasures, mineral and organic, which in former ages slumbered unrecognised in the earth or in the woods, have been detected and brought into play. Various kinds of waste and refuse, which were once a mere encumbrance, are now made sources of wealth. The labour of men and animals, always costly, is in numbers of cases superseded by the cheaper agency of mechanical power, by the steam-engine, and the turbine. The productiveness of the earth is in many parts greatly increased. Above all things the transmission of intelligence and the conveyance of travellers and merchandise, whether by land or water, have been rendered safer, speedier, and cheaper. In this manner the total wealth of the world has doubtless been increased. Doubtless, also, all classes of society enjoy certain conveniences and luxuries to which their forefathers were strangers. But it must be distinctly asserted that life has not, as might be expected, been rendered easier. As a certain weekly organ of anti-vivisectionism and political economy hath it:—"The class which uses its brains works as it never yet worked, and is harassed as it never was harassed before, till physicians are recognising over-work as a specific cause of disease." It is sometimes asserted that the handicraftsmen, those whose labour is to a large extent performed by the muscles, have been the gainers in modern times. In England their hours of work have been reduced, as far at least as the building trades and the large staple manufactures of the country are concerned. But this shortened time does not prevail in all countries, and is indeed one of the special difficulties which the English manufacturer has to contend against as compared with his foreign rivals. Yet it does not extend to the very numerous class engaged in distribution especially by retail. Many persons thus employed enjoy the opportunity of working twelve, or sometimes even fourteen, hours daily. In some of the establishments of the monopolist drapers, which are now becoming so plentiful, the clerks, warehousemen, and other assistants are not unfrequently required to work all night without payment for "overtime," such as the carpenter or the mason receives. But the reduction of working hours, even where it exists, is more apparent than real, if we look back for a couple of centuries. In the olden time holidays were more frequent than at present. Persons still living can name at least one manufacturing town in England where work was not generally resumed between Christmas and New Year's Day. Shrove Tuesday, Easter, May-day, the "feasts" or "wakes" in the villages, and the yearly or half-yearly fairs in the country-towns, all involved the cessation of labour for a day at least. Again, a much larger proportion of so-called working men were, a century ago, engaged either on their own account or were employed by "little masters," whose business was not carried on with the undeviating regularity of a modern factory. The hand-loom weaver of Lancashire or Yorkshire could work when he liked and "play" when he liked. Summing up all these considerations it may be fairly asserted that the handicraftsman devotes a greater number of hours in the year to work than did his predecessors prior to the installation of the "factory system." And what does he earn by the greater regularity and stringency of his labour? Hallam has shown, in his "Constitutional History of England," that in the reign of Queen Elizabeth the wages of a working man represented a greater quantity of the necessaries of life than they have ever done since. In other words, the margin between every man and actual want is narrower than it was formerly. As a matter of course there is much more anxiety. Nor is the case very different in other countries. Dr. Beard says that, in the present day, for the vast majority of Americans, the great question is not "How shall we live?" but "Can we live at all?"

Is this state of affairs, if duly weighed, a satisfactory result, especially in an age which avowedly makes the acquisition of material wealth almost its sole object, and which brands all men not engaged in such pursuit as idlers? What, it may be asked, is the fundamental meaning of that cry for "cheapness" which is everywhere encountered, and which serves as the pretext for so much dishonesty? Surely it means that the resources of the people fall short of their needs to an extent hitherto unprecedented. Times have been when the reverse proportion held good, and when certain classes of people were hence formally debarred by sumptuary laws from indulgences and expenses deemed unfitting their station. Small need in these days for such regulations!

But I may venture to go further: if a man's whole time and powers are taxed—not to say over-taxed—in earning his "living," he exists to no purpose. He may be likened to a machine whose motive power is entirely consumed in overcoming friction. This judgment, that a life spent in merely earning a livelihood is a life in vain, applies alike to cases where such livelihood consists of potatoes and water, in the hovel of a Connemara peasant, and to those where it involves the rarest wines and the costliest viands ever served up in the mansion of a financier. This view may not be fashionable, but that it is capable of being controverted I strongly question. Assuming it as true, I ask is life becoming easier? have men to spend less of their time and powers in earning a "living," and can they reserve more of both for life? Considerations have already been brought forward which answer both these questions in the negative. But every one who has looked around at the world will require no reply.

Before boasting, as some of us are apt to do, of our "labour-saving" inventions,—commonly so called,—let us remember that there are two distinct ways in which such appliances might have been utilised. We have made our choice of the one, and the other is no longer at our option. An illustration will make my meaning clearer. Let us go back to the time when factories were literally *manu*factories. In the village of Elsewhere dwells, say, a weaver, who, by dint of working at his hand-loom for twelve hours daily, contrives to earn that vague something which outsiders term a "decent livelihood." It is plain that he is one of those men above mentioned whose lives are in vain. When his daily toil is ended he has little scope, little ability for anything save rest in its extreme form of bodily and mental inaction. Let us now suppose that he invents and constructs a machine of which others are ignorant, by means of which he can get through his day's work in six hours. He stands now at the crossway, and asks "To the right or to the left?" A moment, and he has decided to take the left-hand road. He resolves to do double the work he formerly did, to earn double the money, and to "rise in the world." I need not describe in detail all that ensues, since it has passed, and is still actually passing, before our eyes. Let us therefore return to the inventive weaver whom we left pondering at the crossway. Suppose he turns to the right! Suppose that he is content to earn the same amount of money as he did before—to live in the same plain style, and to employ his machine, not for increasing production, but literally for saving labour. Suppose that similar inventions are brought to bear in other trades, and are applied on the same principle. What then will be, or rather would have been, the result? No very rapid increase of population or of wealth; but a people vigorous, healthy, unworn with anxiety, working to live but not living to work, and possessing full opportunity for self-culture. Would not such a state of things have been preferable to the feverish struggle into which we have been plunged?

I will now take a glance at some of the more prominent phases under which the failure of modern civilisation makes itself manifest. We have under its inspiration stript our own country, over a great and increasing part of its surface, of every beautiful feature. We have blackened its skies with smoke-clouds, polluted its air with sulphurous acid, filled its streams with liquid filth, covered its hills with "spoil-banks," blighted its green fields, cut down its woods, and extirpated many of its most lovely animal and vegetable species. We have handed over Thirlmere to the tender mercies of the Manchester Corporation, and, though there were abundance of ugly sites available, we have built Barrow-in-Furness where its fumes and its "roughs" may desecrate the vale of Dudden. Our cities, from London downwards, present, as their main feature, meanness, monotony, and ugliness by the square mile, rarely indeed relieved by a street or a single building upon which the eye may rest without pain. If we are ever reminded of man's craving for the beautiful we exclaim that this is a "work-a-day world," a "plain, practical age," and the like. But in those very phrases we pass judgment upon ourselves. Men have always had to work for their support; but till these very "advanced" days they found such work not incompatible with a love for the beautiful. Athens and Corinth of old were great commercial centres; so in later days were Venice and Genoa; Florence and Nuremberg were busy seats of successful manufacturers. But commerce and industry were not in those times considered to necessitate or to justify ugliness. Why should they now? To own that we have not the time, the energy, or the means to overcome the vileness and squalor which surround us, is to confess our modern system a failure.

Let us look at public health and vigour,—the subject most directly touched upon by Dr. Beard and Mr. Herbert Spencer. Here, too, we find the sacrifices which the industrial organisation of society and our dominant covetousness have demanded and received. It is all very true that the average duration of human life has increased, thanks to the greater care taken of infancy, to improved medication, and to cessation (temporary?) of those epidemics which decimated Europe in antiquity. But those diseases which speak of constitutional weakness, and from over-work under anxiety, instead of decreasing seem to augment. Softening of the brain, apoplexy, paralysis, heart-diseases, general debility,—in short, the whole class of "competitive affections," as they might be called,—are now fearfully prevalent. And to them our sanitary reformers say nothing! They wage war against the fever which carries off a man swiftly, but they care little about those lingering maladies which enfeeble successive generations. We are told, on good authority, that among the poorer classes in England mental disease has during the last forty years been multiplying at the rate of 300 per cent, whilst the increase of population is 45 per cent. The late President of the British Psychological Association warned us that if the growth of insanity continues with its present speed the early part of the next century will see in this country more than a million of formally recognised lunatics, not to speak of the greater numbers outside the legal boundary of madness whose morbid whims will form the public opinion and the "national conscience" of the day, and who will constitute the blind followers of the blind. Or shall I rather say Gadarene swine inspired to suicide? On this ground alone the condemnation of modern civilisation may be unequivocally pronounced. Whatever customs, laws, institutions, or tendencies lead to mental disease, need no further investigation.

And what have the morals of the world become under industrial inspiration? We profess to be nothing if not ethicists. We make war, ostensibly at least against the "pleasant vices," but we enter into alliance with those that are profitable. We are clamorous against cruelty, and see it in very novel quarters, but our whole life is permeated with deceit and fraud. Scarcely is any article bought and sold what it professes to be. Scarcely is any business, public or private, done without some form of bribery or corruption. And all these tricks of trade are even defended in high places as merely avatars of the goddess Competition, who dominates us in the University, on 'Change, and in the Hospital. The philanthropy of the modern world is also of a peculiar kind. It shrinks from direct bloodshed, but it is willing to kill by hunger and misery. The fortunes of our "self-made men," in too many cases, cost a greater amount of human ruin and misery than the bloodiest laurels of classic or feudal warrior. The cry for cheap labour, to be gained, if need be, by the importation of the hostile alien, and even of the "heathen Chinee," is as merciless as the yell of Pagan Rome—"The Christians to the lions!"

Or, again, how does man fare intellectually under the industrial *régime?* The answer can be given briefly. All original work—be it in Science, in Literature, or in Art—demands abundant leisure. But the present system is constantly curtailing the leisure of brain-workers. The ultimate result cannot be doubtful. All research not aiming at direct profit will become rarer. We may have inventors, appliers, patentees in abundance,—some of them inventing, perhaps, new frauds; but we shall have a dearth of discoverers.

Lastly, I must ask how far is modern civilisation, under its present guiding ideas, promoting human happiness? To any person of common animal sympathies the weight of anxiety and distress, or else of grim, hopeless apathy, stamped upon the very foreheads of Europeans, and especially of average Englishmen, is a sickening sight. A modern writer remarks that it is impossible to walk the streets of London and look in the faces of those we meet without feeling that nine-tenths of them had better never have been born. Even the successful minority have gained little. They may have at command luxuries such as their fathers never imagined; but what are they benefitted, having not the leisure and the calm necessary for enjoyment? Take the case of a man condemned to penal servitude. Would he feel much happier if his cell were decorated with the masterpieces of the upholsterer and hung with exquisite paintings? Very similar is the condition of the modern capitalist.

Our industrial civilisation, then, is found wanting in every particular. It has broken down more rapidly and more disastrously even than the military *régime* which preceded it, and will be found to have left upon the human race even deeper marks of its failure. The "gospel of rest, of relaxation" is pressingly needed.

IV. VICE AS AN ELIMINATIVE AGENT.

WE are in these days greatly exercised concerning sundry moral reforms. Our philanthropists hold that if certain vices, drunkenness most especially, could be eradicated, an immense benefit, social and economical, would result to the nation at large. In like manner other vices are attacked by special organisations, though it may be noted, in passing, that greed or covetousness—the cardinal sin of the nineteenth century—is mostly overlooked. There has prevailed great diversity of opinion as to the means to be employed in effecting these reforms, and on the comparative efficacy of moral suasion and legal compulsion; but concerning the end proposed we have, till very lately, complete unanimity. Quite recently, however, a different view has been brought forward. Mr. W. Mattieu Williams, in an article in the "Gentleman's Magazine," has sought to show that private vices are often useful to the public by removing a certain class of persons who, if not dangerous, are at least useless. It will at once appear that we have here a reference to the "struggle for existence," which, whether we accept or reject the Darwinian hypothesis of the origin of species, must be recognised as a fact. More recently Mr. John McElroy, in the "Popular Science Monthly," has taken up the same idea, and given it a somewhat wider application. Many men whom we respect will at first glance be shocked at what they will call the "cynicism" of these writers. But it seems to us that their contention has in it an element of truth which has been hitherto thrust out of view, and which deserves serious consideration.

Let us, in the first place, call to mind what the "struggle for existence" really means. Almost every organic species produces such a quantity of spores, seeds, eggs, or young ones, as the case may be, that were no counter-agencies at work the world would soon afford neither food nor even standing-room.

Mr. McElroy writes :—"Even with such limited propagators as the elephant, each female of which produces but six offspring in her bearing period of ninety years, we are told that if the species had no parasitic or other enemies it would be only 740 years until elephants overran the earth. Where, then, should we assign limits to the productiveness of the seven hundred millions of human females on the globe, each of whom is capable of producing twenty children in her thirty years of bearing."

To keep this over-production within limits a variety of agencies are at work. There is a war between individuals of the same species, though, as far as man is concerned, modern politeness gives it the name of competition. In this war the weaker—*i.e.*, those less well adapted to surrounding circumstances—are trodden down. There is war between species and species. One form of life preys directly upon another, or consumes and destroys its nutriment. Diseases carry off multitudes before reaching their normal term of existence. Some animals, noted for their extreme rapidity of reproduction, indulge from time to time in wholesale suicide. The lemmings of Sweden and Norway march in a direct route to the sea, plunge in, and perish. Locusts and various butterflies and moths fly out over the ocean, and are chiefly drowned.

Mr. McElroy, however, is open to the charge of exaggeration when he writes—"Man alone is practically exempt from what is apparently an inseparable condition of all other forms of animal life. While he preys on a myriad of created things, there is no created thing that preys on him and assists in keeping his excessive reproductiveness within the limits of subsistence. Most singular of all, not even a parasite wages destructive war against him."

Now we are of opinion that in many countries a not inconsiderable number of human beings fall victims to tigers, cobras, &c. The *Trichina* is to man a fatal parasite ; so are the flies *Lucilia humanivora* and *L. macillaria*, which not unfrequently kill persons by depositing their eggs in the nostrils during sleep. And if Dr. Thomson, of Melbourne, and Prof. Koch, of Berlin, are not mistaken, the microbion of phthisis is a parasite which inflicts premature death upon about one-third part of the entire human race !

Still for all this mankind in all civilised countries threaten to outrun the means of subsistence. The farmers of Europe dread now American competition. But what will be the state of affairs in Europe when America has no surplus food to export ? Yet that time, if we may judge from the results of the last census in the United States, is already within a measurable distance. In short, as a late eccentric physician once observed to us, "Nature, in her anxiety for the preservation of the human species, has sadly overshot the mark." The late Mr. Bagehot wrote—"How many Irelands have there been where men might have lived happily had they been fewer in number ! "

Now in this grand system of over-production, kept in check by massacre, there is something not soothing to our feelings. Mr. McElroy exclaims—"The benignity of this method of arranging the order of Nature is not so apparent as a member of the Society for the Prevention of Cruelty to Animals might desire." It is true that the weak, who are now produced to suffer and perish, might never have originated. Suppose that every animal and plant, incapable of transmitting a healthy and vigorous organisation to its offspring, had been *ipso facto* incapable of reproduction, a large fraction of the present over-population, and consequent distress, might have been avoided. But we have to deal with what is, not with what might be.

Mr. McElroy's contention is, then, that the elimination of the surplus human population "is accomplished by making vicious inclinations the agents to weed out the redundant growths, and to select for extermination those which are inferior, depraved, weak, and unfit for preservation or reproduction." Again, "The surplus ones relieve us from embarrassment on this score by selecting and exterminating themselves. Their methods of suicide cover a wide range of expedients, but all are very effectual. . . . Each of those chosen for extermination embraces his fate with eagerness, under the delusion that he is about to enhance his own happiness. Immoderate use of stimulants, and the various excesses and errors grouped under the general head of 'dissipation,' a 'life of pleasure,' or the still more expressive phrase 'a short life and a merry one,' are favourite plans of self-annihilation, and leave little to be desired in the completeness with which they do their work." He adds, "Vice is not so much a cause as an effect—not so much a disease as a symptom. Vice does not make a nature weak or defective: a weak and defective nature expresses its weaknesses and defects in vice, and that expression brings about, in one way or another, the sovereign remedy of extermination."

These views are in such flat opposition to the ordinary teachings of the pulpit, the platform, and the press, that they must be carefully examined. If Mr. W. Mattieu Williams and Mr. McElroy are right, our moral reforms and our philanthropic movements are simply attempts to frustrate what is, upon the whole, a beneficent arrangement for the improvement of the human race.

Let us look first at the case of intemperance, taking the word in its modern, technical sense. Our judges, our clergymen, our physicians, and many others who have had exceptional opportunities for observing, tell us that the excessive use of alcohol occasions the greater proportion of our criminals, lunatics, and paupers. The facts which they have at command are merely that the majority of these undesirable classes are drunkards. But are they therefore right in inferring that had they never tasted alcohol they would have been worthy and useful members of society? We doubt it: the *post hoc* and the *propter hoc* are not identical. Let us take an example. George III. was particularly desirous of a long life, and whenever he met with a very old man he cross-questioned him closely as to his habits. On collating the evidence thus obtained, it was found that the only point in common among these men was a habit of early rising. Hence His Majesty drew the inference that early rising was the cause of longevity! But if he had extended his observations he would have found that a far greater number of early risers did not reach an advanced age. The only legitimate conclusion is that early rising, when practised *voluntarily*, is a proof of unusual bodily vigour.

Very similar is the connection between drunkenness and crime. It is probable that in countries where alcoholic drinks are in common use the majority of criminals are at the same time drunkards. But before we conclude that their drunkenness is the cause of their criminality we must first examine the state of affairs in countries where alcohol is not an ordinary beverage, or where at least it is used in much smaller proportions than in England. If we do so we shall find that murder, robbery, and the like, do not become rarer as the consumption of intoxicating liquors decreases.

Mr. McElroy, commenting on the lamentations of temperance advocates that "the demon Alcohol is yearly dragging down to dishonourable graves hundreds of thousands of the brightest and fairest of our land," replies that this is supreme nonsense. "With very few exceptions, every one who goes to perdition by the Alcohol route would reach that destination by some other highway if the Alcohol line were not running."

We often forget what a fortunate circumstance it is for Society that the majority of criminals are men of profligate habits. Were it otherwise they would be far more formidable enemies; they would live longer; their families would be less likely to die out; their plans would be more skilfully laid and executed. Should we ever have a temperate criminal class we shall encounter a danger more serious than most of us even imagine. This hazard is to be remembered when we think of rendering sobriety compulsatory by Maine Laws and Permissive Bills.

Says Mr. McElroy, "It was exceedingly unfortunate for the community that all the leaders in the James Gang were strictly temperate men. Had it not been so their career, instead of extending over twenty terrible years, would have been cut short inside of five. . . . Temperance and chastity, in a rascal of any kind, mean an immense amount of mischief to the community. Fortunately they are quite rare." Less rare, perhaps, of late than they ever were before.

But another consideration here appears. Many a man owes his rise in the world—perhaps even his opportunity for earning a livelihood—to the fact that he has been sober and steady, whilst his competitors, or, in plain English, his enemies, have been profligates or drunkards. But if we compel all men to be sober the struggle for existence will necessarily become more frantic, since a number of the combatants will no longer, as at present, be eliminated. Dr. Lees, in his celebrated prize essay on a prohibitory liquor-law, pronounces the number of men whose lives are shortened by alcoholic beverages a loss to the community, inasmuch as "dead men pay no taxes." But neither do dead men require food and raise its price by the increased demand. Nor do they compete for employment, and reduce by such competition profits, fees, salaries, and wages.

Mr. McElroy further contends that "Whisky makes no man lazy, shiftless, dishonest, false, cowardly, or brutal. These must be original qualities with him. If he has them he will probably take to whisky,—though not inevitably,—which then does the community the splendid service of hurrying him along to destruction, and of abridging their infliction upon the public. People who have done much in the way of reforming drunkards have been astonished to find how little real manhood remained after eliminating whisky from the equation; they have supposed the manhood to be only obscured, and have been disheartened to find how frequently it happens to be demonstrated that there was never enough of it to pay for the trouble of saving the victim of intemperance."

The passage just quoted is open to the charge of exaggeration. There have undoubtedly been reclaimed drunkards who after their reform have merited well of Society. Still we think that in too many instances the drunkard, however bright or brilliant he may appear, is, on the principle that nothing is stronger than its weakest part, an imperfectly constituted individual. He may have great talents, especially the gift of expression, but he is lacking in common sense and in self-command. Hence we notice that, though the propensity to intemperance is common among poets, novelists, orators, musicians, even of a very high order, it is exceedingly rare among men of Science. A drunken investigator of Nature is almost a contradiction in terms.

Mr. Mattieu Williams and Mr. McElroy have been already denounced for their "heartless selfishness" in recognising the efficacy of vice as an agent in eliminating the worthless portion of the community and in securing room for the worthier. We are by no means certain that they deserve this taunt. Neither of them created the struggle for existence. Were population well within the limits of room, employment, and food, we have no doubt that both these authors would rejoice. But seeing that we are plunged into a struggle in which some must go down, whilst others succeed, it is surely well that triumph should be reserved, as far as possible, for the better portion of the community. It is surely remarkable that almost every "movement" of a philanthropic character has for its result, though not perhaps for its object, the intensification of the struggle for existence. In proportion as it is successful it must render life the harder and the less worth living. It is said, by the followers of Darwin, that the struggle for existence is necessary for human improvement. We are by no means certain that such would be the case: in all cultivated animals and vegetables we stamp out this struggle. In our fields and gardens we sow only so many trees or plants as can find sufficient soil, sun, and air, thus preventing all struggles among themselves, and we extirpate as far as possible weeds and noxious animals, thus limiting, if we cannot eradicate, competition with other species; and the result justifies our wisdom. Compare the crop of an ordinary turnip field with that of what might be styled a "competition turnip field," where the roots had been let spring up, grow, and fight it out among themselves. The produce of such a field would not be one-half that of the non-competitive plot, and its finest root would not be worth exhibiting. Is it not very probable that a similar result might follow in a human society where the struggle for existence had been stamped out? No one, indeed, sees clearly how the end is to be reached, but in the meantime we are scarcely wise in working in the very opposite direction.

It may, meantime, be questioned whether every vice cuts short the days of its votaries, and leads to the extermination of their descendants. We doubt if this can be said of the inordinate covetousness of the present day. Says Mr. McElroy, "The policeman on the next corner will bear decided testimony that the number of scoundrels who survive their thirtieth year is astonishingly small." But with perhaps the most dangerous scoundrels of the day policeman *Z 22* has nothing further to do than perhaps to touch his hat to them. The scoundrel now knows how to carry out his plans without breaking the law. He robs not by crying "Stand and deliver!" but by rigging the market. He belongs not to a gang, but to a syndicate, and when he has done more harm than a generation of bandits, burglars, or forgers, he dies in peace, and leaves his children in good positions.

No! Mr. McElroy: it is *not* demonstrable that the proportion of bad men is steadily decreasing. They have assumed a new aspect, and the statistician who should enumerate them would encounter endless actions for libel.

V. THE GLACIAL EPOCH.

By D. Yewdall Cliff.

IS the Glacial theory as set forth in the "Origin of Species" generally acceptable? To me it is not satisfying. The final impression left on the memory is this: that Darwin supposed the Earth's polar axis to have always been pretty much at the same inclination to the plane of its orbit as it is now, and that during the Glacial Epoch the whole Earth was at the same time clothed with ice and snow,—that the cold gradually crept down to the Equator in a "circumpolar" direction. The survival of Tropical vegetation, &c., or the crossing the Equator of the Temperate forms, is alone a very great obstacle, and his explanations are still less assuring. They were before and after, which would effectually silence any fancy as to their anterior evolution or hereditary revertance; the fossil record, incomplete though it be, tells us plainly to the contrary.

But there is another supposition, which has doubtless often been suggested before, which falls in much more naturally with Darwin's theory in general, *viz.*, that the inclination of the polar axis has varied to a far greater degree than it does at present; nay, it may positively have been situate in the plane of the Earth's orbit. *Thus there has always been a polar region,* though probably nothing like as cold as in recent geological time. I write "region" in the singular, because, as we can see, if the polar axis ever lay *in* the orbit's plane radially with the Sun, there would only be one climatic pole, and that on the side opposite to the Sun,—as the Moon in relation to Earth. This would be the nearest approach seemingly to Darwin's Glacial Epoch, and it the severest possible, extending to the present Equator; and the South Pole would be the torrid region. A more remote contingency would be solar or firmamental disturbances, before the present equilibrium was established.

With a widely, though assuredly slowly, oscillating axis, it is easy to see—as its poles travelled all over the world—they would carry in a moving patch, as it were, the Arctic flora and fauna, which would still exist where the temperature allowed,—*e.g.*, mountain-tops; whilst the patch swept on, driving the temperate (and the temperate though tropical, like a shadow before) life kingdom before it, while it was followed behind by temperate, and the temperate by tropical life; thus the whole chasing one another round the world, dividing species like a ship the sea, which closes behind, spreading devastation around in the extermination of species and the denudation of the landscape, followed in its turn by a vastly newer life in respect of time, paving its way with a new formation over the land and sea.

The signs of its progress will be denuded and effaced in a "day" of Geology; it is but the latter of the last part of its last journey, that is too patent to escape our observation. It may have played a far more important part than it is credited with, and the "destruction of species," at which the modern sage so cheaply sneers, may perhaps be something more than a "myth" of the old geologists. It is perhaps within the range of possibility that these times may be astronomically ascertainable.

The more natural an explanation is the more likely it is not only to be more readily accepted, but to be true also. Yet the immensity of the question is so profound that it seems utter audacity on my part to put forward my observation, particularly in criticising a man like Darwin.

Might we not guess at the progress of the Poles? Has it not been more than once in a direction from Europe to America,—*i.e.*, was America its latest station? We know that its life-kingdoms, so to speak, are apparently behind Europe, which must mean an immensity of geological time. The longer the time the more vigorous the species resulting, the struggle for existence having full play; so that, when brought in competition with a less highly evolved series of species it is not surprising that they spread rapidly, and that the reverse seldom occurs. Thus a re-distribution of species is occasioned. Did the South Pole make its last retreat over new Zealand and Australia?

If these visitations have taken place since the islands generally were isolated, will it not explain the absence of mammals, or species of any kind, that could not cross the surrounding seas again? We might guess that, as far as the horse, &c., went, it had swept the American continents from end to end, leaving no side to escape, but driving all before it. If it be shown that there are countries where the old geological fauna and flora exist posterior to what is considered the Glacial Epoch, then this may show that it was visited at a more recent date before the last crisis in Europe. The torrid zone, of course, would always follow the Earth's equators, and fossils recently discovered show this to have been once at London; at the same time the evidence is not entirely satisfactory to show the world was once entirely tropical, or entirely glacial, so that we may fairly conclude that the polar axes have oscillated at any rate over a much wider range than at present. Darwin himself seems puzzled ("Origin of Species," Chap. XI., p. 368) when he explains "that there is enough to show that it is almost demonstrable that what are now the Arctic and Temperate Zones have known a warmer climate than the present" (even) "since the Glacial Period." How utterly impossible had the Poles always been the same. One step further, and the whole matter appears clear as daylight! The existence of northern (Alpine) forms beyond the Equator is proof positive that the "North Pole" must have "crossed the Line," or vegetation been driven concentrically over it, when there was no South Pole, which would further explain why the northern vegetation is not so thoroughly dominant in the south; for as the South Pole turned out of the Sun's radius only one part of the northern cap of ice would push south, whilst the other parts retreated north, and then the South Pole would gradually form a colder and wider nucleus. This would especially be effective if it were possible the Earth had no diurnal motion. Of course in the case I am supposing the Torrid Zone (at the South Pole) would know no night: this would vastly increase vegetative growth. Recent experiments with electricity have apparently demonstrated the fact that plants will continue to grow in the "night time" under the bright light of electricity, and gain on their contemporaries; so that it would not mean the destruction of vegetation, the air being filled with aqueous vapours, &c. But there is no need to suppose that this ever really took place. We must bear in mind that this South Pole would have been at all parts of the world. Again, Darwin says (Chap. XI., p. 371) "the productions of Europe and America during the late Tertiary Stages were more closely allied to each other than at the present time." This would be a time before a Glacial invasion upset the equal evolution. Chap. XI., p. 373, states that evidence of glacial action is visible over Europe from the Pyrenees to the Oural, in Siberia, the Himalayas, New Zealand, South-east Australia, the Cordillera in Chili, and so forth. "We have also excellent evidence that it endured for an enormous time, as measured by years at each spot." It is more to the point when he says "It should be observed that the northern forms found in the southern parts of the Southern Hemisphere, and on the mountain ranges of the Inter-tropical regions, are not Arctic, but belong to the Northern Temperate Zones." But perhaps this may only prove that the southern region has been more equatorial than at present since the Glacial Period (as the northern has been).

Is there any help to this idea in the fact that high regions are rarer far in the Southern Hemisphere? That the Northern Temperate Zone is represented there at all is proof positive of a "northern" visitation, whose Arctic remains would naturally be the first to disappear before a warmer climate. It may be yet another hint as to the progress of the Poles. Altogether one would say, from the fact of the southern life-kingdom being less vigorous than the northern, that it was the more recent region in so far as organic life is concerned. Did it give another extra journey in the north, with a less disastrous effect, the southern seas would allow ample play.

It would be easy to preach on Darwinian texts still further, but I think I have shown sufficiently that if Darwin supposed the earth's axis to have remained pretty much as it is now, his explanation is not at all so satisfactory as the supposition that the polar axle has oscillated very much more widely than at present, if not absolutely revolved in the plain of the Earth's orbit, and probably more than once, —moreover that, as a corollary, the Earth has always owned an arctic region or arctic regions.

[Whilst admitting that Mr. Cliff's hypothesis of a varying position of the poles might account readily for certain facts in the distribution of organic life, we fear that the physicists will deny its possibility.—EDITOR.]

VI. ON TECHNICAL EDUCATION.

By ROBERT GALLOWAY, M.R.I.A.

(Continued from page 164.)

THE opinion is pretty generally entertained in England that all who have, at least, obtained a good average education are versed in the science of Education, and are competent judges of educational systems: then, by a little parity of reasoning, all who have had to receive and expend money ought to be versed in the science of Money; yet it is well known that this is not the case,—that only a very small percentage of the community have any knowledge of money as a whole; and it is equally true that only a very small percentage of the educated portion of the public are really and truly educationists.

Prof. James Bryce, M.P., in his article "The Future of English Universities," in the "Fortnightly Review" for March, refers to the prevailing opinion that anyone who has received a so-called good education is considered to be a thoroughly competent person to undertake the difficult task of improving and reforming our educational institutions and systems. He states, referring to the two University Commissions appointed, by the Act of 1877, to reform the Universities and Colleges of Oxford and Cambridge respectively,—"What have they accomplished? What has been the total result for good of their labours? They received from the Legislature, which no doubt felt its own incompetence to handle such problems, scanty and vague instructions. A large discretion was given them to settle things as they thought best. Some little power of resistance the Colleges had, but it was such as the Commissioners easily could, and often did, overbear. The credit or discredit of the work, therefore, belongs to the Commissioners. Nor, though they were appointed by a Conservative Government, can anyone say that a Liberal Government would be likely to have chosen Commissioners any better qualified for the work. *For the rule in England seems to be, with both parties, to place on a Commission not men of special capacity or knowledge, but persons generally prominent, if not eminent, such as judges and bishops, and leading members of either House of Parliament.*" Mr. Bryce's remarks have a much wider application. Not only do Governments appoint men, to improve and reform our educational institutions, who have never signalised themselves in the least in the science of Education, but they likewise—with the same indifference apparently with regard to the educational progress of the country—frequently place men in prominent positions, in our educational departments, who have never betrayed the slightest qualification for the important duties they have to undertake.

An excellent educator, like a distinguished orator, statesman, musician, or painter, is born one; he is born endowed with those necessary mental qualifications, in a marked degree, which are required for the originating of and carrying out philosophical methods of teaching. There are many examples that those who are not endowed in a marked degree with the talents requisite for the task will not acquire them to the fullest extent by mere education; how few, for example, of all the University men who have occupied the position of a teacher in our grammar schools have distinguished themselves as educationists. The late Dr. Arnold is the one who obtained the greatest public reputation as an educator, and even he does not occupy a position in the first rank of educational philosophers. Mr. Herbert Spencer believes, and I think rightly, that true education is practicable only by a true philosopher; but that is evidently not the opinion of our Statesmen and Members of Parliament, otherwise they would never vote, year after year, the sums of money they do for a system—payment on results—which must extinguish all philosophical spirit in the teachers.

The qualifications required by both teachers and examiners are thus summed up by Mr. Herbert Spencer in his work "The Study of Sociology":—"It becomes clear," he states, "that those having supreme authority suppose, as men in general do, that the sole essential thing for a teacher or examiner is complete knowledge of that which he has to teach, or respecting which he has to examine. Whereas a co-essential thing is a knowledge of Psychology, and especially that part of Psychology which deals with the evolution of the faculties. Unless by special study, or by daily observation and quick insight, he has gained an approximately true conception of how minds perceive, and reflect, and generalise, and by what processes their ideas grow from concrete to abstract, and from simple to complex, no one is competent to give lessons that will effectually teach, or to ask questions which will effectually measure the efficiency of teaching."

The inspection of the classes under the Department and the examination of those taught in these classes are the next divisions of the Department's plan we have to consider. The inspection and examination of the National Schools under the Education Department are combined; but the two functions are not performed by the same persons in the Elementary Science Classes under the Department. Why the Lords of the Committee of Council on Education should combine inspection and examination in one set of schools, and not in the other set, is, to say the least, very singular. It is admitted by all educationists that the two functions ought to be united, and in no branch of study is the union of the two more necessary than in the examination of students in the Inductive Sciences. By not combining the two the examiner never comes in contact with the teacher or the taught; consequently the only test he has of the work and teaching of the schools are the written examination papers. But by no written examination of any kind can it be ascertained whether the examinees have been trained and possess the mental qualifications necessary for being GOOD OBSERVERS and EXPERIMENTERS, and whether they have even acquired the necessary manipulative skill for the latter; and yet observation and experiment are the *fountains* of the Inductive Sciences,—they are the *two* sources from which springs our knowledge of Nature and its laws. As regards those of the examined who only go in for a mere written examination, all that the examiner knows about them is that they have or have not acquired the necessary amount of the names of things.

There are four Permanent Inspectors for the Science and Art Classes, and about a hundred Engineer officers are employed for occasional duty as Assistant Inspectors. Why military men should be singled out as a class to undertake the important duties of inspection would not be an unimportant question for some Member of Parliament, zealous for the educational progress of the country, to ask the Vice-President of the Education Department. It would be interesting to know whether any reasonable explanation could be assigned for these peculiar appointments. That the duty is an important one must be admitted, for good inspection will reveal more as to the kind of instruction given in a school than the mere perusal of examination papers. The inspection, as will be shown further on, costs the country yearly a considerable sum of money.

About twenty-five Professional Examiners are employed in the Science division; they are supposed to—and probably do, although it has not always been the case—set the questions, and they examine *some* of the papers; the remainder of the papers are handed on to a number of Assistant Examiners, who are or were paid so much per dozen papers they examined. This mode of payment for examining the papers must be a strong inducement to the examiner to get through them as quickly as possible; and yet the teacher's payment depends mainly, although not entirely, as we have previously pointed out, on the numbers of marks the examiner assigns to his pupils. The Principal of King's College, London, the Rev. Canon Barry, well observes in his paper, "The Good and Evil of Examination," "that there seems to be too little appreciation of the exceeding difficulty of the task of thorough examination. Examiners are burdened with a mass of work which they cannot get through except in a perfunctory manner, and which even then so utterly wearies them out *that their faculty of judgment and comparison is lost*, and, unless they are strongly belied, are far from preserving an uniform standard in their arbitrary and irrevocable decisions." The late Prof. Augustus De Morgan held the opinion that he could judge of the merits of the competitor from the whole work, but that he could not *reckon it up in marks*; he therefore always refused to examine in that way.

In addition to the Professional Examiners and the Assistant Examiners, there are two Official Examiners. What the duties of these examiners are does not appear; they evidently do not prepare the questions, and it can scarcely be supposed they overhaul the marks the examiners have assigned to the answers in the different papers, as they are apparently not of the same scientific standing as the Professional Examiners, and besides they can scarcely be considered to be competent judges in *all* the different branches of Science which are examined upon.

Written examinations fail utterly to test attainment in any of the Inductive Sciences, as they would equally fail to test the artistic power of the painter or the sculptor; and this is known to all who are practically conversant with any one of these sciences. I have never met a chemist yet who would engage a party as his Laboratory Assistant if his sole qualification for the post was that he had passed a written examination, however severe the examination might have been; because the party requiring the Assistant would know that he could not, without practical instruction, turn any chemical information he might possess into practical power. What would be the value, for instance, of one learning, either from a book or a teacher, all the tests for arsenic? If he could not actually put in practice that information it must simply hang like dust about the brain, or dry like rain drops off the stones. Does not such useless information represent the kind of information the majority of the students acquire, in the Department's schools, of one or more of the Inductive Sciences; and from the miserable way the teachers are paid the evil is increased, as we have seen that some of them, in order to gain little more than a bare subsistence, have to teach some of those sciences of which they themselves have no practical knowledge. Then why is it that those in authority continue a system which can neither benefit the taught nor the State? Mr. Herbert Spencer supplies, in his "Sociology," a general answer;—"It becomes," he says, "manifest that, in common with the public, those in authority assume that the goodness of education is to be tested by the quantity of knowledge acquired. Whereas it is to be much more truly tested by the capacity for using knowledge,—by the extent to which the knowledge gained has been turned into *faculty*, so as to be available both for the purposes of life and for the purposes of independent investigation. Though there is a growing consciousness that a mass of unorganised information is, after all, of little value, and that there is more value in less information well-organised, yet the significant truth is that this consciousness has not got itself officially embodied, and that our educational administration is working, and will long continue to work, in pursuance of a crude and out-worn belief."

(To be continued.)

ANALYSES OF BOOKS.

Snakes : Curiosities and Wonders of Serpent Life. By CATHERINE C. HOPLEY. London : Griffith and Farran.

A POPULAR treatise on serpents may safely be pronounced a novelty. Birds, beasts, and fishes—even insects to some extent—have an attraction for the general public, and figure accordingly to no small extent in modern literature. But reptiles, and especially serpents, are viewed, even by tolerably intelligent persons, with a vague horror. No one beyond the very limited circle of professed naturalists cares to inquire into the attributes and the habits of these creatures. To do so is, indeed, regarded by certain of the "unco' guid" as slightly profane. Accordingly we are by no means surprised at reading the following passages in Miss Hopley's introduction :—

"I learnt enough of snake nature to feel safe in proceeding with my book of 'Adventures,' and in presenting it to a publisher. 'As a gift-book no one would look at it, and as an educational work there would be no demand for it,' was its encouraging reception. . . . For the space of two years the sequel to my 'American Pets' went the round of the London publishers of juvenile works, and to several in Scotland. It was read by many of them who professed to have been extremely interested in it, but none could be persuaded to 'entertain so repulsive a subject.' One member of a publishing house, distinguished for the high standard of its literature, positively admitted, among its insurmountable objections, that when a child his mother had never permitted him to look through a certain favourite volume late in the day 'for fear the pictures of snakes in it should prevent his sleeping!' An editor of a magazine told me he should lose his subscribers if he put snakes in its pages, and another made the excuse that his children would not look at the magazine with a snake in it."

Such being the positive repugnance to instruction in this branch of Zoology, we need not wonder at the ignorance concerning serpents which prevails. We find educated people still regarding the harmless, and indeed impotent, tongue of snakes as a deadly sting. Still less can we feel surprise at the confusion that exists in their nomenclature and synonymy. We find several species, some harmless and others deadly, bearing the same name, whilst in return one and the same species figures in different countries, or even provinces, under a variety of names. We need only give as an instance our only venomous British snake, *Pelias berus*, which in some districts is known as "adder" and in others as "viper." Waterton, in a way remarkable for an out-door naturalist, speaks of the adder and the viper as two distinct species. The viper he pronounces poisonous, whilst the adder is, with him, a "harmless little fellow, very useful in clearing the fields of mice." Possibly he gives the name adder to the grass-snake (*Tropidonotus natrix*), which, however, is much more given to prey upon frogs than mice.

Miss Hopley's object is the very laudable one of giving in a popular form a correct account of serpents, drawn as far as possible from actual observation, supplemented by reference to such modern works as Dr. Fayrer's "Thanatophidia of India," Dr. E. Nicholson's "Indian Snakes," &c.

Here it must not be forgotten that the study of living snakes may perhaps before long be practically proscribed in England. Serpents, it is well known, can only be fed on living prey. Hence our "zoophilists," who experience no qualms when eating an oyster alive, consider, *e.g.*, the reptile-house at the Zoological Gardens an outrage on their sensibilities, and, for anything we know to the contrary, as a "grievous national sin." We believe the Zoological Society has made a concession to this clamour by causing the serpents to be fed only at night.

Miss Hopley makes a passing reference to the "benevolent organs," and rationally enough defines "cruelty" as unnecessary torture. Among the questions here discussed we find "Do snakes drink?" with an answer in the affirmative. We never had the good fortune to see a snake drink when in a state of freedom. We know, too, that many species haunt parched localities, where moisture in other shape than that of dew and occasional rain-drops is not too plentiful. But the observations brought forward by Miss Hopley seem perfectly conclusive. Perhaps, however, all species of serpents may not be alike in their fondness for liquids.

The relish for birds' eggs displayed by some snakes is an indisputable fact, greatly to the annoyance of farmers' wives in warm climates, where the poultry yard is often plundered on the large scale. Milk is also very attractive to the cobra and other species. Perhaps these two propensities might be turned to account for reducing the number of certain snakes by leaving poisoned milk and eggs (the latter marked) where they might be swallowed by these marauders.

The "Snakes of Fiction and of Fact" is the title of a very interesting chapter. Here mention is appropriately made of a lecture on "Snakes" given at the London Institution in March, 1880, which, as our authoress tells us, was "artistic, poetic, figurative, imaginative, but not zoological."

The hybernation of reptiles and the opposite stage of æstivation observed in some very dry and hot countries are fully and correctly described, but, as there are here no erroneous notions to expose, the subject calls for no discussion. A curious phenomenon of kindred nature has been recorded by Dr. Cantor. The sea-snakes of the Eastern Ocean (Hydrophidæ) are sometimes found so soundly asleep on the surface of the water that they are not aroused by a ship passing among them.

In connection with hybernation, the authoress mentions some cases of large numbers of snakes which had collected together under manure-heaps, &c., for the purpose of passing the cold season. We have more than once found large heaps of the eggs of snakes—far greater in quantity than could be deposited by any ten females of the species in the district—amongst decaying leaves and other vegetable refuse. We do not find in the work before us any notice of the alleged mass meetings of snakes which are said to have been observed in warm weather, both in the Eastern and the Western Hemispheres.

The chapter entitled "The Tail of a Snake" contains mention of some curious notions held in former ages. It was supposed that several serpents—such as the horn-snake of Virginia, described by Lawson—are armed, in addition to their poison-fangs, with a sting at the end of the tail. It was said that if the sting was by chance struck into the bark of a young tree, the tree instantly withered.

In such a work as the one before us the "Great Sea-Serpent"—to some people a name for any and every thing fictitious—cannot be wanting. Like most writers who have given the subject a candid examination, Miss Hopley inclines to the belief in the existence of huge marine ophidians. There is some amount of direct evidence in the affirmative, *e.g.*, the case of the *Pauline*, whilst the only negative evidence—the non-occurrence, as far as has been observed, of vertebræ and other remains of such huge serpents—has been invalidated by a recently recorded fact. An American vessel, engaged in a dredging expedition, succeeded in bringing up from the bottom no relic of human or other vertebrate life, save an india-rubber doll; yet the region explored was one where sharks, dolphins, &c., abound, and where many shipwrecks have happened. Hence it is fair to infer that the skeletons of animals which perish in the sea are, as a rule, rapidly disintegrated. Thus we have small grounds for wondering that no remains of any giant ophidian have hitherto been dredged up.

The chapter on the "Venoms and their Remedies" embodies the modern views based on the researches of Fayrer, Nicholson, &c. The difference of kind between the secretions of different species is recognised; but the great question, whether the active principle in any case is a ferment or a definite chemical compound, is not discussed. It is asserted that "the blood of an animal killed by a bite, if injected into the veins of another animal kills that also. But is the proportion of blood thus injected as small as that of the original poison, and is death brought on in the same manner and with the same symptoms?

Incidentally we notice some incidents sadly out of harmony with Waterton's assertion that serpents never take the offensive or pursue a foe.

Concerning the question "Do snakes afford a refuge to their young?" Miss Hopley gives an answer in the affirmative.

Bringing our short notice of this volume to a close, we must say that it has given us no small pleasure. We believe that, if read as it deserves, it will dispel some groundless prejudices and correct not a few obstinate errors.

The Micrographic Dictionary. A Guide to the Examination and Investigation of the Structure and Nature of Microscopic Objects. By J. W. Griffith, M.D., &c., and Arthur Henfrey, F.R.S., F.L.S., &c. Fourth Edition. Edited by J. W. Griffith, M.D., &c., assisted by Rev. M. J. Berkeley, M.A., F.L.S., and T. Rupert Jones, F.R.S., F.G.S. Pp. 829. 53 Plates, 818 Woodcuts. Two vols. London: John Van Voorst. 1883.

A notice of a portion of the above work has already appeared in a previous number of this Journal. Its completion enables a further analysis to be given. As was anticipated, the book is a great improvement on the last and former editions, not only from its enlargement, but also from the careful manner in which the information has in most instances been brought as close to the date of publication as possible.

Owing to the form of issue in parts, in which the plates and their explanations, and the introduction, appeared irregularly, little could be said of the work in the former review, founded on the perusal of only a small portion.

The Introduction retains its accustomed form and place: alterations and additions have in general been made in accordance with the advance that has taken place since the issue of the last edition.

In treating of the stage of the microscope it is a singular omission that no mention should be made of the concentric rotating stage, which, owing to the advocacy of Dr. Carpenter and the keen competition among opticians, is now applied to many of the cheaper forms of microscope as well as the larger instruments, and adds greatly to their utility in permitting objects to be examined with great facility under illumination, in extremely varying directions.

The remarks on object-glasses are good, and notice is taken of the important work done with high powers and immersion objectives: the reason of their superiority is explained in the article "Angular Aperture."

The distinction between water and oil immersion lenses seems to have escaped notice: the latter or homogeneous system, originally devised by Mr. J. W. Stephenson, to save the trouble and uncertainty involved in adjusting for the thickness of the cover-glass, and afterwards shown by Prof. Abbe to possess additional valuable properties, chiefly aperture, far beyond the limit of glasses working through air or water, and that precious quality to the working microscopist, increased working distance.

The description of the Achromatic Condenser, good as it is, would have been much improved by the mention of the illuminators constructed on the immersion principle, rendered necessary by the employment of immersion objectives, as, if a condenser working through air is used with an immersion-glass, its aperture is reduced to 1·0 numerical aperture = 180° in air. So to obtain the full benefit of the augmented aperture, the condenser must be adapted to transmit its pencil through the same medium as that of the objective. Such illuminators have been designed by Abbe, Stephenson, Powell and Lealand, and others.

The concluding portion is occupied by practical directions for the use of the microscope, and carrying on observations by its means, and mounting and preparing objects.

With respect to the Dictionary proper, a considerable extension is apparent when compared with the previous editions. The student is much assisted in finding what he requires by an extensive series of cross-references, and those who wish to extend their reading will find all they require in the copious list of books and papers at the end of each article. A short quotation will afford the best illustration:—

"ILLUMINATION.—This has been specially alluded to in the Introduction (p. xxviii.), and in the articles 'Angular Aperture,' 'Diatomaceæ,' 'Polarisation,' and 'Test-objects.' But several papers have been published in recent years, describing new and ingenious methods of illuminating the finer and more difficult objects, to which we can only refer.

"BIBL.—Higgins, *Qu. Mi. Jn.*, x., 150; Abbe, *M. M. Jn.*, xiii., 77; Smith, *ib.*, 88; Wenham, *ib.*, 156, and *Engl. Mechanic*, 1877, 279; Whittell, *ib.*, xiv., 109; Bramhall, *ib.*, xvi., 102; Osborne, *ib.*, xvii., 179; Moorehouse, *ib.*, xviii., 29; Woodward, *ib.*, xviii., 61; Edmunds, *ib.*, xviii., 78; Schulze, *Jn. Mic. Soc.*, 1878, 45."

The treatise "Rocks," by Mr. Frank Rutley, is a valuable addition, and is accompanied by Plate 42, containing twenty-four coloured figures of mineral sections viewed by polarised light. Much practical information is given as to the peculiar mode of observation required in examining mineral structures. Here the polariscope does most important work, and is used in a much more delicate manner than is usual with the generality of observers. A new field of research is now open to the microscopist and geologist. The figures on the plate certainly show that textures hitherto considered homogeneous, owing to the neglect of suitable means of observation, possess a vast amount of structural detail. These discoveries have resulted in the formation of that branch of Mineralogy known as "Petrology," which bears the same relation to Geology as Histology to Biology in general.

The Plates are interleaved with very full explanations, which can easily be utilised for the purpose of reading the book by its illustrations, and referring from them to the text, as may be required, a method suggested and carried out very perfectly by Dr. Beale, in his "How to Work with the Microscope." Plate 2 will be found very useful, as it contains figures illustrating some of the more common forms of adulteration.

The book can be strongly recommended to those students who wish to learn, as for those who wish only to pass manuals are legion.

Darwin and Modern Evolution. An Address delivered to the Essex Field Club, January 27th, 1880. By Raphael Meldola, F.R.A.S., F.C.S., &c., Retiring President.

Concerning the former, or what might be called the business portion of this interesting address, we need say little beyond expressing our satisfaction at the progress of the Essex Field Club, and at the work it is evidently doing. This work is of a two-fold nature, it is concentrating and systematizing the labours of local geologists, botanists, entomologists, archæologists, &c., many of whose observations might otherwise fail to be recorded; and it provides an organization for defending the interests of Science, whenever needed. We have had very recently proof that the lovers of Nature, if once organized, form a power which the authorities, local and national, will have in future to take into account. We only hope that other similar bodies throughout the realm may exert themselves as successfully as the Essex Field Club has done, under the able and zealous guidance of its late President, and that all may co-operate whenever there is any good end to be secured, or any threatened evil to be warded off.

Turning to the more general part of the address, it must be admitted that the life and work of Charles Darwin form no easy subject to handle. So much has he, especially during the last twelve months, occupied the attention of the intellectual world, that little can be said concerning him which has not been to some extent anticipated. We have, therefore, the greater pleasure in recognising in Mr. Meldola's "Address" certain points which may usefully engage our attention. He accentuates especially the fact that Darwin was "a field naturalist as distinguished from a museum naturalist,"—in fact, a magnified and intensified type of the class of whom Gilbert White was one of the earlier representatives. Experiment and observation were his very life, living plants and animals were always appealed to if possible. We must here quote a suggestive note of the author's :—"The difficulties besetting the experimental investigator are forcibly recalled to my mind by a remark once made to me by Mr. Darwin. Speaking on this subject, I said that Nature when thus questioned often gives an evasive answer, to which he replied, 'She will tell you a direct lie if she can.'" Such being the state of the case we have need of all methods of research, direct and indirect, of experiment and observation modified in every conceivable way, that the one may check the other. Whoever, therefore, would deprive us of any one method seeks to cripple, if not to arrest, our progress. It is idle for him to say that other methods yet remain to us. We cannot fly with one wing ; we want both.

Passing from these considerations, the bearing of which can scarcely be misinterpreted, we come to a very just remark. Mr. Meldola declares it surprising how much the Darwinian theory is still misunderstood by the general public. "Ask any non-scientific person what he imagines to be conveyed by the word Darwinism, and he will probably tell you that it is the theory that man is descended from a monkey, which is about as explicit as saying that the Newtonian theory of gravitation is something to do with an apple." Nay, as he goes on to show, there are many extreme specialists in Science who vaguely accept the Evolution theory in words, and yet have no conception of its practical importance. It is with them a dead formula to which they bow, not a principle animating their studies. These misconceptions—or rather misrepresentations—Mr. Meldola combats with a clearness calculated to ensure conviction. The Address before us, brief as it necessarily is, may be safely recommended as a preliminary study for outsiders who wish to know for themselves what Darwinism really is, before attacking longer and more elaborate treatises.

Proceedings of the Scientific Association of Trinidad. Part XII. December, 1881. Port of Spain : J. Wulff. London : Trübner and Co.

We are exceedingly glad to find that a Scientific Association has been established in Trinidad and has got fairly to work. The locality is exceedingly favourable for research in many branches of biology. Situate as it is at the extreme verge of the Brazilian subregion of the great Neotropical Region it forms a connecting link to the Antillian subregion, and its birds, reptiles, insects, and mollusks offer to the animal geographer a most interesting field of study. The aquatic fauna of its shores has also not yet been studied with the needful thoroughness. The kind of work that that can be done by the mere collector, whether by land or by sea, has been to a great extent accomplished, at least as far as the more showy species are concerned. But the more important subjects of the development, the life-history, and the habits of a fauna can be worked out only by the resident. We should like to see in all the British colonies individuals, or better still societies, who are like, *e.g.*, Dr. Fritz Müller in South Brazil, making a close investigation of their respective districts.

The coast of Trinidad would, it seems to us, offer an excellent position for an aquarium. We mean, of course, not a place of random amusement like some of the establishments which have sprung up in England, but of honest experiment and research, like that of Naples, or the one which is just being inaugurated on the coast of New South Wales.

The "Proceedings" before us contain a paper by R. J. Lechmere Guppy, F.L.S., on the Land Shells of St. Vincent. During a stay of three weeks the author took sixteen species, of which six are common to the islands north of St. Vincent, seven to Grenada, seven to Trinidad, and five to the mainland of South America. Only three species are common to all these five localities. Mr. Guppy states that land shells are much scarcer in St. Vincent than in Grenada and Dominica, and others of the Antilles.

The same author also contributes a paper on the "Recent and Tertiary Species of *Leda* and *Nucula* found in the West Indies, with Notices of West Indian Shells."

Mr. Guppy has also communicated a description of a Heterocereal Fish found in the Blue Limestone of the Laventille Hills, on the east of Port of Spain, for which he proposes the name *Acanthodes elongatus*. He has read also a memoir on the fossil Echinodermata of the West Indies, of which he notices twenty-six species.

Might we express a hope that the Scientific Association of Trinidad will use its influence with the Government and the public to obtain some protection for birds similar to that which prevails in Demerara?

Magnetism. By Thomas P. Treglohan. London: Longmans and Co.

This work is a fair average specimen of the Science-Manuals in which the press of England is so exceptionally fruitful. The author tells us in his Preface that the work has been written "to supply a want long felt by students who are preparing for examination in the Elementary Stage of the Science and Art Department, so that the subject may be simplified and their studies facilitated by treating it under the divisions laid down in the Syllabus of the Department." In other words, it is written with the primary object of enabling intending examinees to to "pass" the fashionable ordeal. As an Appendix follow the "Science and Art Department Questions in Magnetism" from the years 1867 to 1882 inclusive. Skilful "coaches" will of course be able to calculate the chances of the recurrence of any of these questions, and can "prepare" their clients accordingly.

In connection with this subject we cannot help referring to a most able article on "Brain-power in Education," which appeared not very long ago. The author contends and shows that examinations, competitive or otherwise, are no tests of brain-power. They test, if anything, the relative skill of those who train the candidates. He mentions an instance where, without any collusion, seven out of the thirteen questions actually occurring in an examination paper had been predicted as due by an experienced "coach," and his pupils had been drilled accordingly. A well-stored mind is by no means necessarily a suggestive mind, capable of dealing rightly with unforeseen emergencies. The writer is even heretical enough to say that "if we required an accurate test of brain-power we should be far more likely to obtain correct results by an examination in whist than we should by an examination in mathematics." He further remarks, most truthfully, "The mere routine man will almost invariably bring about a disaster when he has novel conditions to deal with, and as a rule the routine youth comes out best at an examination."

Victorian Year-Book for 1881-2. By H. HEYLYN HAYTER. Melbourne: J. Ferres and G. Robertson. London: G. Robertson.

WE have here an extensive collection of information, statistical, historical, and topographical, most of which, however, will have but little attraction for our readers.

In the remarks on the population of the colony it may perhaps be noted, as a satisfactory feature, that whilst the British subjects have increased by 19·78 per cent the proportion of aliens has been reduced by 17·42 per cent, during the ten years from 1871 to 1881. The number of Chinese, who nowhere seem to amalgamate with an Aryan people, has fallen by 33·93, or more than one-third. The colony may be congratulated on the absence of any appreciable negro or negroid element, which, wherever existing, appears to be a source of danger.

The religious census of 1881 disclosed the existence of 151 distinct denominations. Amongst these we find one Positivist, one Iconoclast (!), and three worthies who state their creed to be *£. s. d.*, and whose sincerity at least will not be called in question. The excess of births over deaths in the entire group of Australian colonies is remarkably high, ranging from 228 per cent in New Zealand to 87 in Tasmania, numbers which appear the more striking when it is added that the excess in Europe varies from 59 per cent in Scotland to 8 per cent in France. The average death-rate varies from 12·38 per 1000 in New Zealand to 17·86 in Queensland, that of England and Wales being 21·7. The mortality from phthisis is relatively much lower than in England, but appears to be increasing, which is a very sore subject in Melbourne.

Snake-bites are recorded as having occasioned five deaths in Victoria in the year 1881,—a fact which shows that there is room for the services of the mungus and the secretary-hawk.

The criminal statistics present certain remarkable features: thus whilst only 12 per 1000 of native Victorians, and 29 per 1000 natives of the other Australian colonies, of persons born in England and Wales 43 were arrested, of Scotchmen 44, Irishmen 86, but of Chinese only 20 per 1000.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

DO SNAKES SWALLOW THEIR YOUNG?

To the Editor of the Journal of Science.

Sir,—In the "Standard" of March 5th I find the following with reference to Miss Catherine C. Hopley's book on "Snakes," just published:—"We are rather glad to find that she believes in serpents swallowing their young for protection, and she has some very curious reflections on the subject which might be pursued further." And "Land and Water" of February 24th, in speaking of it as a "vexed question," said—"We are inclined to agree with Miss Hopley. We are aware that some high authorities still look upon the case as not yet satisfactorily proved. We hope the evidence brought forward in Chapter XXVII. will set a fresh number of observers on the alert, and that the fact of ophidian mothers continuing their care over their baby offspring may be made clear to all."

I thought that I had settled this question in "Contributions to Natural History, &c.," published at Edinburgh in 1875, and again with an Appendix in 1880. It would have been interesting if "Land and Water" had told us who the "high authorities" are that "still look upon the case as not yet satisfactorily proved," and of the kind of evidence they want; and why other observations should be made and printed, while mine—which are so minute, so scientific, and I think so conclusive—should be treated as if they had no existence." On that head I wrote in "Contributions, &c.," as follows:—

"A scientific or even common-sense naturalist will not necessarily stoop so low as to demand ocular proof of snakes swallowing their young. He ascertains that *vipers* pass their young with a covering on them,—the original egg attenuated to the last degree,—which breaks as it leaves the mother, or immediately after it touches the ground; and are killed with young inside of them, sometimes upwards of 7 inches long, and divested of a covering; and he concludes at once that the young were swallowed. And his opinion is confirmed by the fact of *oviparous* snakes being killed with young inside of them that were hatched in the soil, which proves beyond doubt that they must have been swallowed. Ocular testimony confirms the opinion, in *both* instances, that the young were swallowed" (p. 195).

The only point to be settled, so that it "may be made clear to all," I have alluded to as follows:—

"I consider the testimony so complete that nothing could be added to it, although it would be very interesting to have a careful examination of the anatomy of the snake to ascertain the physical peculiarities connected with the phenomenon described" (p. 3). I am not aware of the throat of a snake having been examined to see whether it could allow an instant passage for her young. There is nothing to justify us in supposing it could not, especially at the time nature calls for it. If a throat were examined, it should be that of a snake that was alleged or supposed to have swallowed her progeny" (p. 26). "It has often occurred to me that the female snake must have two throats,—one for ordinary purposes, and the other to give a passage to her young; or one throat for a certain length leading by a valve, as it were, to another that enters the chamber that contained the eggs, and which doubtless becomes the receptacle of the young when hatched. It will be difficult to find this passage unless when it is in use, for it will become so contracted at other times as to escape any observation that is not very minutely made" (p. 36). "The next thing to be considered is the anatomy of the snake immediately after the birth of her progeny; but that could not be so easily ascertained as that she swallows them" (p. 39).

White of Selborne's definition of the phenomenon alluded to, *viz.*, that the viper "opens her mouth and admits her helpless young down her throat on sudden surprises," is more correct than the shorter one, "swallowing," in common use. The conclusion which I drew from my researches on this subject, and which I have not seen controverted, was the following:—

"Besides *vipers* swallowing their young, I repeat what I have said in the work (p. 29), 'I lay it down as an axiom that we must hold that *all* snakes (when living in a state of nature) swallow their young, till the opposite can be proved of any particular species of them'" (p. 198).

It has often surprised me that so simple a question as this should have been considered a "vexed" one, in the case of such common-placed animals as vipers, or snakes of any kind, and that it has not been "settled" within a century after being prominently brought into notice by White of Selborne, when it should have been decided in "three minutes by the clock" on the evidence so elaborately furnished by me. I notice, from "Land and Water," that Miss Hopley prepared her book from attendance at the Zoological Gardens and a visit to America, and from writers on the subject from whom she has "quoted copiously." Not having yet seen her work I do not know whether she has made any reference to the two issues of mine. However I have sent her a copy of it, in case she has not seen it, so that she may make a use of it if her volume appears as a second edition. In my "Reminiscences of Childhood at Inverkeithing" (p. 59) I said that I had submitted all the evidence on "the viper swallowing her young" to the publishers of the "Encyclopædia Britannica," in December, 1881. On that occasion I wrote as follows:—"In the last edition the subject was not noticed. . . . In the forthcoming article on the Reptilia the question it is hoped will be settled 'once for all,' so that it may never again come up for discussion. If it is again omitted, the article will have left out what might be said to be 'the most interesting trait in the snake family.'"—I am, &c.,

JAMES SIMSON.

New York (P. O. Box 2887)
March 21, 1883.

THE BRAIN THEORY OF MIND AND MATTER.

To the Editor of the Journal of Science.

SIR,—Should any of your readers who are interested in the "Brain Theory of Mind and Matter" care to examine the framework of propositions on which is based the argument adopted in a paper on that subject which appeared in your issue for March last, I venture to draw their attention to three of these propositions:—

I. "All the perceptions" of man "have a merely subjective existence."

This the Authoress of the paper in question sets forth as her major premiss, remarking that it is one which "no one has ever been able to deny, though many have fancied that they were denying or confuting" it.

Here it is convenient to note that the minor premiss, "The Brain is a perception of man," leads us to the conclusion that "the Brain is subjective."

Let "Perceptions of man" = P
"Subjective" = S
And "Brain" = B,

And we have—

All P's are S,
B is a P,
∴ B is S,

II. Our Authoress *rejects* " that Absolute Idealism which will deny the existence of aught that is corporeal, even of the sensifacient hemispheres (B) and of the sensiferous nerves."

But to deny the existence of the sensifacient hemispheres and of the sensiferous nerves is to assert their subjectivity, and therefore Absolute Idealism asserts that B is S.

Now we have already seen that from the proposition all P's are S, to come to the conclusion that all B's are S is unavoidable, and at this conclusion Absolute Idealism arrives.

Our Authoress, in confessedly "rejecting that Absolute Idealism" which she " by no means adopts," proves that it is that part of Absolute Idealism that asserts that B is S which she rejects, by the admission that (III.) she is " forced to accept " a " Relative Idealism, which declares that the only Cosmos known to man is manufactured in his own brain-cells," while she maintains that the "real existence of matter" (Cosmos) "can be denied only by a metaphysical quibble." Now this admittedly *real* existence she declares to be manufactured in the brain-cells, which must therefore, as the cause of reality, be also themselves " real," *i.e.*, non-subjective, which is equivalent to the assertion that matter and its manufactory, the brain, are not subjective,—that B is not S.

But granting her own proposition, that all P's are S and that B is a P, we have found them to lead to the inevitable conclusion that B is S, which we now see our Authoress denies ; but she herself admits that all P's are S, and since B is P, and " B is not S," our Authoress denies what she asserts, *viz.*, that all P's are S.

We are therefore driven to the conclusion that the framework of the argument in favour of " Hylo-Idealism," or the " Brain Theory of Mind and Matter," which "contends for identity of Object and Subject, of Ego and of Non-Ego, also contends for identity of Yes and No, of Sense and of Non-sense.—I am, &c.,

T. P.-L.

THE WILL OF ANIMALS.

To the Editor of the Journal of Science.

Sir,—Noting the paragraph in the "Journal of Science" for April to the effect—" If the human will can produce effects without the intervention of bodily organs, why may not the will of other animals do likewise ? "

Some people may be sceptical of this statement, and being somewhat interested in the subject would be glad to learn what demonstrative evidence there is of it, whether described in your Journal or in any other. Does it refer to the article relating to the experiments of Mr. Bishop with Dr. G. M. Beard (July, 1882, Ser. 3, p. 407)?

I am particularly anxious to learn whether there is any other statement referred to; the note in question is so meagre in its details.—I am, &c.,

T. NETTLEFOLD.

[We had no intention, in the passage referred to by our correspondent, of expressing a conviction that the human will can produce direct effects either upon other animated beings or upon inanimate matter. Our own observations have led to a negative result. But we are well aware that the question is now attracting much attention, and that there are eminent authorities who have come to an affirmative conclusion. We did not refer in any special manner to the experiments of Mr. Bishop or of Dr. Beard. Evidence bearing on the subject is to be found in the "Journal of Science" for 1881, pp. 87, 151, and 561. We may also refer our Correspondent to a Lecture which has recently been delivered before the Maidstone Natural History Society, by Dr. Monckton, and to the "Proceedings of the Society for Psychical Research. —ED. J. S.]

REPLY TO MR. W. BRAYSHAW.

IF you are a *bona fide* student of Science we think you will find the cultivation of the power of observation more important than that of memory. Note down, of course, the particulars of all your observations and experiments, and keep your reading available by the use of Todd's "Students' Index." If, however, you are merely preparing for some examination you may find the "System of Memory," of which you speak, serviceable.

NOTES.

HERR HANS GADOW, in a memoir on the colours of feathers (" Proc. Zool. Soc.") divides them into three classes:—

1. Objective, chemical colours, due to a black, brown, red, orange, or yellow pigment.

2. Objective colours depending on structure. The feathers may either contain (*a*) no pigment, and the colour depends entirely on structure,—*e.g.*, white, and sometimes yellow,—or (*b*) the feather contains a yellow or brown pigment, and the green, blue, or violet colour is produced by a peculiar transparent layer between the pigment and the surface. Of the non-iridescent colours blue and violet always depend upon structure. Green is derived from the refraction of a yellow pigment. Green pigments have been found very exceptionally.

3. The iridescent colours are produced by transparent sheaths which act like prisms.

According to M. Meyer the colour of distilled water, if viewed in a horizontal glass tube 7 metres in length, is of an intense blue by daylight, but by gaslight of a green.

M. Pasteur has studied the pneumo-enteritis of pigs, which has carried off during the last year more than 20,000 swine in the Valley of the Rhone. He traces the affection to microbia, much smaller than the bacilli detected by Dr. Klein.

According to the " Gazette Hebdomadaire de Medecine " a man living at Cuantla, in Mexico, is suffering from an anomalous disease in which the skin falls off in large patches. His sister died lately from the same affection. The malady is locally attributed to the circumstance that their mother ate largely of the flesh of the rattlesnake.

It appears that Leonardo de Vinci studied the transmission of sound, and observed that if the bell of a trumpet was immersed in the water of a lake, and the ear applied to the mouthpiece, the noise of boats sailing at a great distance could be distinctly heard.

Dr. F. L. Oswald (" Popular Science Monthly ") contends, in opposition to Buckle, that fanaticism is not the result but the cause of ignorance.

According to M. Ch. Montigny (" Bulletin de l'Academie Roy. Belgique ") the twinkling of the stars is much intensified during the appearance of the northern lights—those especially in the northern region of the skies.

H. G. Baur (" Morpholog. Jahrbuch," viii., p. 417) has undertaked a special study of the tarsi of birds and deinosaurians, and finds that this part in embryonal birds is closely similar to that of the deinosaurians, a fact which renders it extremely probable that the latter are the progenitors of birds.

According to the " Scientific Proceedings of the Ohio Mechanics' Institute " the average weight of man at Boston is 154·02 lbs.; that of woman 130·87 lbs. In Kentucky—men, 158·43 lbs.; women, 133·52 lbs.

According to " Der Techniker " a Breslau hotel is now lighted up with gas distilled from human excrement. Should there occur in the gas-fittings a *hiatus valde deflendus*, and a consequent escape,—what then ?

Mr. Jabez Hogg (" Medical Press and Circular ") states that he has observed myriads of living bacteria in water filtered through spongy iron.

According to the " Medical Times and Gazette " the deplorable custom of making the Lord Rectorship of Scottish Universities a political question still continues. For Edinburgh the " Liberal " candidates are Earls Granville, Rosebery, and Selborne, Viscount Sherbrooke, Mr. Trevelyan, and Mr. Campbell-Bannerman, whilst the " Conservative " nominee is the Duke of Albany—all, in our opinion, unsuitable.

Our attention has been drawn to a biographical sketch of Prof. Ernst Haeckel, which Dr. E. B. Aveling contributes to the "National Reformer." Curiously enough Haeckel has been—of course accidentally—ignored by " Men of the Time," and other English authorities, on the lives of eminent contemporary characters.

The same journal, in comment upon the experiments of Mr. C. Lloyd Morgan, remarks :—" The defence for vivisection is that by means of it, all animals, including man, are saved from disease and pain." This defence we must repudiate altogether, since it merely covers experiments made for direct medical purposes, and leaves purely biological experimentation out in the cold. *Our* defence—though we pass no opinion upon Mr. Morgan's experiments—is that if it be permissible to inflict pain and death for any purpose whatever, this may be done for the sake of discovery.

Messrs. Irving Bishop and " Stuart Cumberland," the thought-readers, are quarrelling in face of the public, and putting questions as to each other's antecedents.

A writer in " Light " records an instance of the spirit of a canary appearing, invisible to man, but visible to another canary, which learnt the song of the visitant. We have always held that the evidence for the immortality of the lower animals is substantially the same as that for the immortality of man.)

The Rev. O. Fisher ("Geological Magazine") argues that if the interior of the earth be as rigid as glass or steel, the crust must be more rigid than glass or steel, which is a *reductio ad absurdum*.

At a meeting of the Philadelphia Academy of Natural Sciences ("American Naturalist") Mr. Mehan exhibited a nest of *Chætura pelasgia*, made of cherry twigs fastened with gum, and suggested that the gum was cherry gum, and not, as stated by Audubon, the saliva of the bird.

Professor Nordenskiold, during his Arctic expeditions, was struck with the great rarity of recent animal remains. He states that in Spitzbergen it is easier to find vertebræ of extinct reptiles than the bones of the seals and sea-fowl of the present day. (The rarity of the remains of birds, small mammals, and reptiles in all countries is difficult to account for.)

"Medicus," writing in the "Truth-seeker," complains that about a year ago an eminent and highly-qualified candidate for the Chair of Physiology in the University of Michigan, was warned that he must not teach the "development theory." (Academical freedom will always remain a myth as long as the heads of colleges are LL.D.'s and D.D.'s, classical scholars, theologians, historians, and, in general, men of words.)

We much regret to announce the unexpected and premature death of Dr. G. M. Beard, of New York, a highly valued contributor to the "Journal of Science." His decease took place on January 23.

MM. Oliver and Richet ("Comptes Rendus") have discovered microbia,—chiefly bacilli,—in the blood and lymph of all the species of fishes which they have examined.

Mr. G. T. Rope ("Zoologist") notices that, in Normandy, toads are often affected with a disease which begins in the nose, and gradually eats away a considerable part of the head, the cavity being full of maggots. (Are not the maggots the cause of the disease?)

M. Beaunis ("Comptes Rendus") has measured the time required for the perception of olfactory sensations, and finds it vary from 37 hundredths of a second in case of ammonia to 67 hundredths in phenol. Olfactory sensations are perceived less rapidly than those of sight, hearing, or touch.

Professor Goltz concludes from his researches that the theory of circumscribed portions of the cortical substance of the brain, subserving especial functions, cannot be maintained. Intelligence, sentiment, the passions, and the natural appetites, are not localised in portions of cortical substance capable of acting separately. The limited destruction of any part whatsoever of the cortical substance is unable to paralyse the action of a muscle in a permanent manner, or to withdraw it from the action of the will.

Herr J. Kühn describes a half-breed, between a Gayal bull from Further India and a cow of the long-horned African race common in the Soudan.

Mr. H. C. Hovey ("American Naturalist") records the case of a cat which had become completely blind from cataract, but which is still a capital mouser, and succeeds in finding its way home from a distance, even when the ground is covered with snow.

M. Timiriazeff, in a study on chlorophyll ("Comptes Rendus"), notes that the position of maximum energy, as fixed by Mr. Langley in the orange ray, corresponds precisely to the characteristic band of chlorophyll (between B and C). Chlorophyll seems able to convert into work 40 per cent of the energy absorbed.

M. de Chardonnet ("Comptes Rendus") has studied the penetration of the solar radiations in the eye of man and of the vertebrate animals. He proposes the law that no medium of the eye in the vertebrates is transparent for waves shorter than T or U, the limits of the ultra-violet solar spectrum. The vitreous body presents a mere trace of fluorescence in the sparrow-hawk; the fluorescence of the cornea appears in the owl and the carp, the cat, and the sheep. The crystalline lens is generally fluorescent.

Dr. J. Blake, in a communication to the Academy of Sciences, combats the view of M. Rabuteau, that the toxic power of metals is simply proportional to their atomic weight, and shows that this merely holds good in one and the same isomorphous group.

Herr Ludwig ("Botan. Central-Blatt") has shown that under certain circumstances *Agaricus tuberosus* is distinctly phosphorescent.

Herr Röhmann ("Pflüger's Archiv. Phys.," xxix., p. 509) has proved experimentally that so long as the nutriment is normal the intestinal canal can perform the functions necessary for the preservation of the organism, even in the absence of bile. The phenomena of putrefaction noticed by earlier observers occur only when the diet contains fat in abnormal quantities.

M. Dareste ("Comptes Rendus") confirms his former result that the longer the interval between the laying of an egg and the beginning of incubation the greater the probability of the development of a monster. The change, however, is much more rapid in summer than in winter.

According to Balduino Bocci (" Central-Blatt Med. Wissenschaft "), human urine injected under the skin of frogs occasions paralysis, and sometimes even death. Upon mammalia the poisonous action is slight.

The Revs. V. G. McNally and E. H. Sugden, B.A. (" Light "), assert that the power of thought-reading is practically universal.

The " writers of the Perfect Way " (" Light ") consider that " a knowledge of the physical is an indispensable aid to the comprehension of the metaphysical." This admission will appear significant to anyone who examines the physical teachings of that modest volume.

M. A. Gaudry, in a communication to the Academy of Sciences, considers that in the Silurian epoch the majority of the animals appear to have been better organised for defence than for attack. He points out that each of the epochs of the globe has had forms which reached in it their highest development, and then passed away, whilst less powerful types have proved permanent. (This is, in fact, Mr. Cope's " doctrine of the non-specialised.")

Dr. Haldemann reports, in the " Cincinnati Lancet " and the " Popular Science Monthly," that the brain of a mulatto, who died lately at Columbus, Ohio, weighed 68¾ ozs., or nearly 5 ozs. more than that of Cuvier. The man was " illiterate and not very intelligent."

The " Popular Science Monthly " mentions also the case of a bricklayer, whose brain weighed 67 ozs., but who could neither read nor write.

According to the " Amtsblatt des Landes Kulturrathes für Bœkman," the frequency of thunderstorms decreases inversely as the latitude, and from the centre of continents towards the coast. The numbers given are :—On the equator almost daily; Java, 97 yearly; Sumatra, 86 ; India, 56 ; Georgia, 55 ; Borneo, 54 ; Gold Coast, 52 ; Italy, 38 ; Antilles, 36 ; Lower Guinea, 32 ; La Plata, Canada, and Austria, 23 ; Baden, Wurtemberg, and Hungary, 22 ; Silesia, Belgium, and Bavaria, 21 ; Holland, 18 : Saxony, Brandenburg, and Kasan, 17 ; France, Australia, and South Russia, 16 ; Spain and Portugal, 15 ; Slesvic Holstein, Mecklenburg, Hanover, West Prussia, and Cape Town, 13 ; Mesopotamia, 12 ; North Russia, 10 ; Sweden and Finland, 8 ; England, Astrabad, and the Alps, 7 ; Norway, 4 ; Cairo, 3 ; Egypt (Upper ?), and Turkestan, scarcely any.

The Hygienic Congress of Geneva offers a prize of 2000 francs for the best essay on the causes and prevention of blindness, The Bill for the total abolition of physiological experimentation introduced into the House of Commons by the Bestiarians, was simply "talked out." It is particularly gratifying to find that the Home Secretary could see no reason for increasing the stringency of the existing law. The public seem recovering from the "anti-vivisection" mania, and if the medical profession and men of Science generally do not relapse into carelessness, there is room to hope that the agitation may subside, and that its agents may have to seek some more useful method of earning a livelihood.

A. W. S., writing on Kangaroo hunting in the "Squire," tells us that a female kangaroo when hard pressed by the dogs, pulled her young one out of her pouch, dragged it in the path of her pursuers, and by thus sacrificing her offspring made good her own escape.

Dr. J. K. Kellogg ("Chicago Sanitary News") "can recommend tobacco to kill vermin of all kinds, except a kind of parasite that breeds in bar-rooms and billiard-halls, and may often be seen adhering to lamp-posts."

Beet-root sugar is now admitted to be distinct from cane-sugar. Its sweetening power is at least 30 per cent. lower, whilst its polarising power is greater. Hence, to sell beet-root sugar (betose) at the price of cane-sugar is a fraud.

March last has had at Brussels a mean temperature of only 1·9° C., as against an average of 5·3°. There have been 20 days of frost, the average number being only 8. ("Ciel et Terre.")

C. F. Krukenberg ("Verhand. Physik. Med. Gesell. Würzburg,") in a recent study of the colouring matter of egg-shells, confirms the existence of oorhodein, described by Mr. Sorby and Herr Liebermann. He gives to Sorby's oocyan the name of biliverdine, and the yellow and red ooxanthine of the same physicist he terms respectively oochlorine and ooxanthine. The other colours described by Mr. Sorby he has been unable to recognise. All flesh-olive or leather-coloured shells, and all which are spotted, sprinkled, or marbled with red, brown, or black, and all spotted or scribbled with ash-grey, contain oorhodein, rarely unmixed with oocyan. Oocyan is found in all green and blue egg-shells. Oorhodein is wanting in all the Cursores and in the Crypturidæ.

Dr. Monckton, lecturing on "The Human Will and its Correlatives," before the Maidstone Natural History and Philosophical Society ("Light") asks, "Can mind-effort produce anything else than internal mental results without physical mediation? Can one mind act immediately on another mind? Can it affect another's bodily organisation? Can it operate on inanimate objects without physical intermediation?"

Are we to rest content with the mere defeat of the recent Antivivisection Bill? Will it not be well for persons introducing or supporting such Bills to find that in any future election the vote and influence of all medical and other scientific men will be arrayed against them, irrespective of party politics?

The "Medical Record" rightly pronounces the common saying that men die not of work but of worry a mere quibble.

Fruits ripened by the electric light are found to be deficient in flavour.

We regret to find that the so-called "Conservators" of Epping Forest are still proceeding with deep drainage and other operations calculated entirely to change the character of the place.

An evil-disposed boy at Brighton saturated the fur of a cat with petroleum and then set her on fire. For this piece of wanton cruelty he escaped with the moderate penalty of £3 12s. 6d. Had a physiologist inflicted one-tenth of this torment upon any animal, he would have been fined £50 besides being preached about, prayed at, caricatured in novels and poems, and perhaps pilloried upon some new "Peak of Darien."

M. Amans ("Comptes Rendus,") has been engaged with a series of researches on the wings of insects. To our no small disgust we find that his object is aërial navigation.

The University of Glasgow is again about to indulge in the election of a Lord Rector on political principles. It is time that this discreditable custom should be suppressed.

MM. Gaston Bonnier and L. Mangin ("Comptes Rendus") show that in fungi the volume of oxygen absorbed is greater than the volume of carbonic acid produced. The proportions in one and the same species do not vary with temperature. The intensity of respiration augments sensibly with the degree of atmospheric moisture. Respiration is diminished by diffused light, and is more intense under the blue and violet rays than under the red and yellow.

Dr. A. Mayer proposes the use of glass coffins, to be filled with carbonic acid gas, and hermetically closed! The great objections to this scheme are the expense and the withdrawal of so much combined nitrogen and phosphates from circulation.

We regret to find in the "Popular Science News," formerly known as the "Boston Journal of Chemistry," the following remarks concerning Pasteur:—"He is a steadfast believer in spiritualism (?), and takes no interest in evolution theories or positivist doctrines." Will it never become known that evolution and positivism are not merely unconnected, but mutually antagonistic?

According to M. Poincaré ("Comptes Rendus"), prolonged exposure to the vapours of creosote has a hardening effect upon the brain, the liver, and the kidneys. The lungs assume a faint grey colour, and the pulmonary cavities are effaced.

M. A. Lebedeff ("Neueste Erfindungen") has proved experimentally that foreign fats, taken as food, pass directly into the cellular tissues.

Law-makers have fixed a minimum age for marriage, going in some countries absurdly low. But why have they never laid down a maximum limit, and why do medical authorities condone the omission?

The U.S. surveying-steamer *Blake* has effected a sounding to the depth of 4561 fathoms, or above 5¼ miles, between Bermuda and the Bahamas, in lat. 19·41 N. and long. 66·24 W. The locality is not far from the deepest Atlantic soundings (3862 fathoms, or 4½ miles) of the *Challenger* expedition.

Prof. Lemström, of the Finland Meteorological Observatory, has obtained a direct proof of the electric nature of the aurora.

It is said that a Dr. Guidrah, of Victoria, has invented an instrument for conveying luminous action by electricity, so that a perfect picture of objects or events at distant places may be projected on a plate of metal. This invention, if it be as described, will be far more useful that the telephone.

M. J. Gazagnaire ("Comptes Rendus") investigates the importance of the zoological characters furnished by the labrum in the Syrphidæ. He concludes that its form has an absolute value for the family, whilst its modifications have a generic value for *Ceria*, *Humerus*, and *Volucella*.

According to M. Janson the optical characters of watery vapour in the atmosphere of Venus are very slight.

It appears that the great magnetic perturbation of November 17th was experienced at Cape Horn.

The "Medical Press and Circular" suggests that "whilst open drunkenness has diminished, secret indulgence in narcotics and sedatives has enormously increased."

MM. Prevost and Frutiger ("Comptes Rendus") have proved experimentally that in subacute poisoning with mercuric chloride there occurs calcification of the kidneys, parallel with the decalcification of the bones.

M. L. Jourdain ("Comptes Rendus") has studied the lymphatic system of tadpoles of frogs. He finds that their chyliferous system in the larval state is comparable to that of the adult Urodelæ.

M. A. Sanson (" Comptes Rendus ") describes *avenine*, a stimulating principle present in oats and distinct from vanilline. It appears to act upon the motor cells of the nervous system.

M. Dieulafait, in a communication to the Academy of Sciences, signalises the close relation between zinc and magnesium, and shows that the former metal is always found in dolomites and other magnesian rocks. Magnesia is always accompanied by manganese.

A great quantity of pre-historical human skeletons, implements, &c., have been discovered at the southern extremity of Lake Ladoga.

According to Dr. Fessenger (" Bulletin Generale de Thérap.") ærobic vibrios can vegetate in phenic solutions, whilst the anærobic forms are absent.

A new journal is announced under the title of " Tabooed Topics," which, amongst other subjects, is to discuss vegetarianism, teetotalism, vaccination, and vivisection ! We do not see in what sense the discussion of these topics has been " tabooed," and on one of them at least much more has already been said than is necessary or beneficial, save perhaps to professional agitators.

" Light " gives narratives of the appearances of the spirits of deceased cats, horses, and birds.

We regret to learn the sudden death of Prof. Zeller, editor of the " Stettiner Entomologische Zeitung," and acknowledged for many years as the *facile princeps* of modern Micro-Lepidopterists. His first paper appeared in 1838 in Oken's " Isis," and stamped him at once as equally acute and thorough in observation and clear and accurate in description.

According to M. Ball (" Revue Scientifique ") original thought borders closely upon insanity.

Dr. C. A. Cameron (" Medical Press "), in a memoir read before the Public Health Section of the Academy of Medicine in Ireland, pays a tribute to Southwood Smith, Andrew Combe, and Chadwick, but by some accident overlooks the true father of Sanitary Reform, Dr. G. Walker.

It is sad to learn that an eminent medical practitioner, formally commissioned by the Society for the Advancement of Medicine to examine the parasitic theory of phthisis, is obliged to proceed to Toulouse and Berlin in order to conduct his investigations, owing to the interference of the Anti-Vivisection Act.

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THE
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JUNE, 1883.

I. REICHENBACH AND THE PSYCHICAL RESEARCH SOCIETY.

NEARLY forty years ago the scientific world and the more intelligent classes in general were startled by an announcement in Liebig's "Annalen." Baron von Reichenbach, who, though not a chemist of the highest order, was still favourably known as an experimentalist, had observed luminous appearances over the poles of powerful magnets, at the ends of the axes of certain crystals, and upon a number of other bodies. These phenomena Reichenbach ascribed to a yet undiscovered form of energy, to which he gave the name of Od. At once not a few enquirers attempted to verify the author's results, but in general with but indifferent success. The misfortune was that, on Reichenbach's own admission, these lights were not visible to all mankind, but only to a minority, whose sight was abnormally delicate. The very name which had been selected was, for England at least, very unfortunate. The majority of our countrymen would persist in pronouncing it as if written *odd*, and thus affording scope for petty joking. Others made matters worse by tacking a classical tailpiece to Reichenbach's Teutonic monosyllable, converting it into *odyle*. Thus the idea was insinuated that the unknown something was not a phase of energy, but a material organic compound, analogous to ethyle, methyle, propyle, &c. Before very long *od* was dropped. The physicists ceased to experiment for, on, or with it, and, despite the august sponsorship of Liebig, it was handed over to that semi-scientific limbo where exploded delusions await decomposition and neglected truths their resurrection. Latterly, however, the Psychical Research Society have turned their attention to this subject, and have submitted Reichenbach's researches to a very careful and impartial revision.

The preliminary question may be raised, Why should the Psychical Research Society engage in an enquiry so purely physical? To this query it is not easy to give a satisfactory reply. Still the solution of a difficulty should be none the less welcome, by whomsoever it is furnished; all that we have a right to ask being merely—Is the solution genuine? The experiments undertaken by the Society, and described in detail at the meeting held in Willis's Rooms, April 24th, if not entirely decisive, have upon the whole an affirmative character, and in short justify the public in concluding that "there is something in it." In other words, our verdict must be given in favour of Reichenbach, unless some quite unexpected source of error is detected on further experimentation. The persons chiefly engaged in the research were Prof. Barrett, Mr. W. H. Coffin, Mr. E. Gurney, Mr. E. R. Pease, Dr. A. T. Myers, Messrs. F. W. H. Myers, H. N. Ridley, and W. R. Browne. The experiments were made at No. 14, Dean's Yard, Westminster, in a perfectly darkened room. The first point to be considered is whether the darkness was truly absolute? It was asserted that not a glimpse of light was perceptible to observers "even after an hour's immersion in the darkness." We understand, also, that the room was always darkened for a considerable time before the experiments began, so as to eliminate error from the possible presence of phosphorescent light. This precaution is the more necessary since our knowledge of phosphorescent bodies is far from exhaustive. From various considerations it is possible that most substances may be feebly phosphorescent. Hence the most satisfactory arrangement for the class of experiments in question would be a room permanently darkened. In the dark room was fixed an electro-magnet of the power of from 200 to 300 lbs. Conducting wires were carried to a commutator in the next room, and thence to a Smee battery of sufficient power. The room where the commutator was placed was separated from the darkened room merely by curtains, so that what was said in the one was distinctly heard in the other. In this darkened room, where was the magnet, were stationed, as we understand, Prof. Barrett, Dr. Myers, Mr. F. W. H. Myers, and Mr. Ridley. The commutator in the room on the other side of the curtains was in charge of Messrs. W. H. Coffin, E. Gurney, and E. Pease. It will be at once perceived that the three last-mentioned gentlemen could, by making and breaking the current at such intervals as they thought fit, alternately create and annul the power of the magnet. Hence if a light was produced over the poles of the magnet on making circuit, and disappeared on interruption, it might be fairly concluded that the magnetism and the luminosity were causally connected.

The next point relates to the observers. Unfortunately not all persons are capable of perceiving this light. Of forty-five subjects tested, three only were able to perceive anything. Of these three the most successful were a Mr. G. A. Smith and a boy, Frederic Wells. It is right to add that both these had been to some extent engaged in mesmeric operations. It is, however, expressly stated that "both of them were entire strangers to these experiments, and disclaimed any knowledge of Reichenbach's work. In the first instance they were not told what to look for, but merely to note if they perceived anything amid the darkness, and if so, what, and where."

The English version of Reichenbach's work, by the late Prof. Gregory, is, we believe, out of print, and rarely to be met with. From the circumstance, however, that Dr. Ashburner repeated Reichenbach's experiments, the work is perhaps more known amongst persons who dabble in mesmerism than it is elsewhere. Hence, without pronouncing Smith and Wells to be tainted with imposture, we think it would be well if the experiments could be repeated with subjects not conversant with mesmerism.

We turn now to the experiments themselves, and consider in how far they demonstrate the reality of the phenomena sought for, and, as a necessary condition, how far they eliminate the possibility of trickery or collusion.

The operators being placed in charge of the commutator, and the observers being posted in the dark room, the sensitives, Smith and Wells, were introduced,—as it appears separately,—and after some time each declared that he saw a faint light or a luminous vapour. Each declared that this appearance was over the poles of the magnet, the one—the so-called north pole, or rather north-seeking pole—being the brighter of the two. The light was pronounced to be in the form of wavering cones, running to a point where touching the magnets and growing wider upwards. A current of air —*e.g.*, the breath—was said to drive the flame aside, but not to extinguish it. Various substances—such as a board, or a piece of velvet if laid in a flat position over the poles of the magnet—seemed not to affect the light, but it was at once obscured if these objects were held between the magnets and the eyes of the "sensitives." If, as we understand, this interception was effected without their knowledge,—as would be quite possible in a dark room,—we have here valuable evidence of their good faith.

The most decisive proof is, however, the following: the sensitives always proclaimed that the light had disappeared whenever the current was interrupted. In a series of test observations made upon Smith, which lasted for more than an hour, contact was made or broken for fourteen times in succession. The intervals were intentionally varied from a few seconds to several minutes; yet, as the operators in the other room testify, Smith's exclamations, "It's there" and "It's gone," coincided exactly with the movements of the commutator. Hence it seems legitimate to conclude Smith saw the light when the current was established, but ceased to see it on interruption.

If this was not the case we must have either casual coincidence or indications obtained in some other manner. The supposition of casual coincidence Prof. Barrett disposes of very satisfactorily. There are in an hour 3600 seconds, in each of which there was an equal antecedent chance of the circuit being formed or interrupted. Hence the probability of even a single right guess is very small. But the chance against hitting fourteen right moments in succession, without a miss intervening, is so many millions to one that it may be practically dismissed as out of the question.

The more important consideration is whether the conduct of the experimentalists and observers, or any circumstances connected with the experiments themselves, might furnish the sensitives with a clue to what was taking place. On this subject we prefer to quote the exact words of Professor Barrett, in the "Philosophical Magazine." He says:—"Among such indications the so-called 'magnetic tick' at once suggested itself. Knowing precisely what to listen for, and therefore more keenly alive to the sound than Smith, who presumably knew nothing of this molecular crepitation, I failed to detect the faintest sound on the making of the circuit, and a barely audible tick on breaking contact was heard only when my ear was in close contact with the magnet or its support. This was due to the massive character of the magnet and stand, which also prevented any other discernible movement when the magnet was excited. Further I satisfied myself that, at the distance at which Smith stood from the magnet, it was impossible to discover when the circuit was completed by the attraction of any magnetic substance about one's body: as a precaution, however, Smith emptied his pockets beforehand." Prof. Barrett adds, however, "At the same time it is quite possible a skilful operator, bent upon deceiving us, might be able to detect the moment of magnetisation and demagnetisation by feeling the movement of a concealed compass-needle. Against this hypothesis must be placed the fact that no information was given to Smith beforehand of the nature of the experiment."

The possibilities of imposture are further greatly lessened by the experiments made with the boy Wells. His perception of the luminous phenomena appears to have been more acute and sensitive than that of Smith. In the preliminary trials he saw the light earlier than Smith had done. The flame, according to his description, was larger and brighter than it appeared to Smith. To the latter, moreover, the light on breaking contact disappeared immediately, and he accordingly exclaimed "It's gone." To Wells it seemed to die away, rapidly but not instantaneously, and he therefore said, "Oh, you are spoiling it." Prof. Barrett here points out that there was still a large residue of magnetism left in the electro-magnet after the current was interrupted. We do not learn whether any experiments with permanent horseshoe magnets were tried with Smith; but with Wells some very valuable results were obtained in this manner. He saw the luminous appearance on the poles of both: when they were silently removed without his knowledge he detected at once their new position. Says Professor Barrett, "Holding one of the magnets in my hand, Wells told me correctly whether I moved the magnet up or down, or held it stationary: this was repeatedly tried with success."

It was further ascertained that no effect was produced by these magnets upon a small compass-needle, even at one-tenth of the distance at which Wells stood. Hence the compass trick, to which Prof. Barrett referred, would in this case be ineffectual. Moreover, it is scarcely conceivable that a baker's shop lad would be familiar with this method of detecting magnetic action.

The next question which suggests itself concerns the compatibility of the luminous phenomena observed with known laws. We by no means mean to intimate that theories ought to override facts. But it will be granted that if some novel observation is found to be in harmony with our previous knowledge, we feel much better satisfied with its accuracy than if it appears irreconcilable and anomalous. If a luminous appearance hovers over the poles of magnets it will not have arisen *de novo* as a creation of energy, but will be a work of transformation. In the case of the electromagnet we have no difficulty: we have electricity converted into magnetism, and need feel little surprise if the molecular disturbance occasioned in the metal of the magnets, or in the air immediately in proximity to them, expresses itself as light, or as some other form of energy not yet known. Prof. Fitzgerald, F.R.S., refers to the well-known fact that the gases of the atmosphere differ in their magnetic relations, oxygen being strongly magnetic, whilst nitrogen and carbonic acid are decidedly diamagnetic. Hence a process of molecular disturbance in contact with a powerful magnet is to be expected. Again, it is well known that the atmosphere holds in suspension minute solids, which have also their magnetic relations. To determine whether either or both, or neither, of these relations come here into play, he proposes an experiment to which we shall shortly refer.

But whilst these or some kindred theory may probably account for the luminosity over the poles of an electromagnet in full accord with the great truth of the conservation of energy, the case might seem at first glance dubious with a permanent magnet. But here the question is raised whether there is not a very slow loss of magnetic power gradually and constantly at work, the energy thus lost reappearing as light, or, if anyone prefers the term, as *od*.

The "Reichenbach Committee" of the Society for Psychical Research promise that, when the simple fact has been fully established, they will proceed to a further examination of the nature and properties of *od*. With all due submission we doubt whether the simple fact will ever be accepted as established until some progress has been made with these investigations. Prof. Fitzgerald, in order to test his own suggestions, recommends observations with a magnet in a medium approaching as nearly as possible to a vacuum. To this might be added experiments in air freed from suspended solids by filtration through cotton-wool; in pure hydrogen, in oxygen, in carbonic acid, and in other gases and gaseous mixtures. Further points are the passage of the od-light through lenses of power and nature unknown to the sensitive observer, its reflection from plane and concave mirrors, by which means all possibility of trickery could be obviated. Not less important is the spectroscopic, polariscopic, and photographic examination of the light.

It does not appear that the Committee have as yet attempted to verify Reichenbach's original experiments with crystals, and on a number of other bodies. Thus there is indeed a vast assortment of work awaiting them,—some of it, as we must admit, of no small difficulty. But whilst we would warmly encourage these investigations, and are prepared to welcome the results, whether the phenomena are traced to *od* or are merely novel manifestations of some form of energy already known, we must again express our inability to recognise their connection with Psychical Research, and still less with Spiritualism. As far as we see, there is in Reichenbach's phenomena nothing which need be unacceptable even to the most determined Positivist, or to anyone who regards the phenomena commonly attributed to soul, spirit, or mind as the mere outcome of organisation. True certain persons can perceive the magnetic luminosity, whilst others fail so to do. But this fact seems to us to stand upon the same plane as the well-known differences between man and man in the recognition of colours, in the perception of remote or minute objects, and in the hearing of very acute sounds.

II. ATLANTIS ONCE MORE.*

THE question of "lost Atlantis," which most of our readers will have considered as finally disposed of, has been reopened in a most remarkable work, which, whatever conclusion we may ultimately form, deserves a fair examination. The author undertakes to prove not merely that there once existed a large island, or possibly continent, where now extends the Atlantic ocean, but that it was densely populated and highly civilised, being the seat of a vast empire, with colonies extending from the Ganges and Central Asia to Peru and Vancouver Island; that it was suddenly submerged in a tremendous convulsion of Nature; and that all the culture of antiquity was due either to refugees who escaped the crisis or to settlers who had previously left the island.

It is plain that we have here a group of propositions not necessarily inter-dependent. If we grant a former land-connection between Europe and America, it does not follow, of course, that such must have still subsisted since the appearance of man upon the earth. Admitting the existence of Atlantis in the human epoch, we may still question its catastrophic doom and its claim to be the cradle of civilisation. In support of his conclusions Mr. Donnelly adduces a vast mass of evidence of the most varied kinds, and drawn from diverse sources. History, mythology, philology, not less than geology, zoology, and botany, have been ransacked with a wonderful amount of patience and enthusiasm, We shall not be surprised if, in the opinion of many of the outside public, he is held to have proved his point. The scientific world will naturally feel more sceptical. They will at once remark that direct evidence of the existence of such an island is wanting. Such eminent authorities as Mr. A. R. Wallace, Dr. Carpenter, Mr. Murray (of the *Challenger* Expedition), and Professors Agassiz, Dana, and Le Conte, conclude that the great oceans have occupied their present position, if not through all geological time, yet from an epoch prior to the origin of man. Perhaps our best course will be to examine the fourth chapter of the work before us, in which the author asks if the sudden disappearance of such a tract of country is possible? In reply to this question he recounts evidence proving the elevations and subsidences of large tracts of land, and the sudden havoc produced by earthquakes and volcanic action. But he seems to us to overlook the important consideration that the extensive elevations and submergencies were slow, gradual, and secular, whilst even the widest catastrophe wrought by earthquakes is in comparison extremely limited. Some of his authorities agree extremely ill with the conclusions they are adduced to support. Thus he quotes Prof. Geikie to show that "the earliest European land appears to have existed in the north and north-west, comprising Scandinavia, Finland, and the north-west of the British area, and to have extended thence through boreal and arctic latitudes into North America." Here, then, is a land-connection between the eastern and western continents, but not in the latitude assigned to Atlantis, which is placed about the Azores. "Within five thousand years," Mr. Donnelly writes, "the shores of Denmark, Norway, and Sweden have risen from 200 to 600 feet." So be it; but the occurrences of subsidences and elevations in certain places does not prove that such changes have occurred everywhere. They show, indeed, what *may have been*, but fall very far short of telling us what *must have been.*

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* Atlantis: the Antediluvian World. By IGNATIUS DONNELLY. London: Sampson Low, Marston, Searle, and Rivington.

In this section we find certain further misapprehensions. Mr. Donnelly writes :—" There can be no question that the Australian Archipelago is simply the mountain-tops of a drowned continent which once reached from India to South America. Science has gone so far as even to give it a name; it is called Lemuria." Now the hypothetical Lemuria was supposed to lie not in the Pacific, but in the Indian Ocean, extending from Madagascar to Ceylon, or perhaps Sumatra. The supposition of a continent reaching from India to the Peruvian coasts is exceedingly questionable.

Mr. Donnelly gives his opinion that " the Desert of Sahara was once under water, and its now burning sands are a deposit of the sea." This view is now, we may say, exploded. Dr. Lenz has found in the Desert fresh-water fossils, and its sands are considered to have been formed by the disintegration of the rocks, long exposed to intense heat by day, to a comparatively low temperature at night, whilst unprotected by vegetation.

We come now to the second part of the author's argument, where he seeks to show that there is nothing impossible or improbable in the sudden disappearance of an island like Atlantis. The convulsions and eruptions which he cites do not make even a remote approach. The most extensive is the subsidence of the fort and village of Sindree, on the eastern arm of the Indus, caused by an earthquake in 1819. This tract is 2000 square miles in extent. Now Mr. Donnelly gives the island of Atlantis a breadth of 1000 miles by a length of 2000 to 3000 miles. Hence its area would be from two to three *million* square miles! It is safe to say that we have no catastrophe on record which approaches even from afar the sudden disappearance of such a region. Further, the land about the mouths of the Indus is of exceedingly unstable character. The branches of the river often change their position to such a degree as seriously to interfere with engineering operations. Atlantis, on the other hand, is described as rocky and mountainous, not a stretch of alluvial sands and muds, such as are generally found in the deltas of large rivers.

We must therefore conclude that the sudden overthrow of Atlantis, if not impossible—a word which scientific men are not fond of using—is highly improbable. As far as this part of the subject is concerned we must return a verdict of "not proven."

We turn now to what the author entitles the " Testimony of the Sea." He lays great stress on the so-called " Dolphin " and " Challenger " ridges, the former of which was found covered with volcanic deposits. He contends that "when these connecting ridges extended from America to Europe and Africa they shut off the flow of the tropical waters to the north; there was then no Gulf-stream; the land-locked ocean that laved the shores of Northern Europe was then intensely cold, and the result was the Glacial Period. When the barriers of Atlantis sunk sufficiently to permit the natural expansion of the heated water of the tropics to the north, the ice and snow which covered Europe gradually disappeared; the Gulf-stream flowed around Atlantis, and it still retains the circular motion first imparted to it by the presence of that island." He adds:—"It does not follow that at the time Atlantis was finally ingulfed the ridges connecting it with America and Africa rose above the water-level. These may have gradually subsided into the sea, or have gone down in cataclysms such as are described in the Central American books. The Atlantis of Plato may have been confined to the Dolphin ridge."

Here, then, we have a novel theory of the Glacial Epoch. Is it sufficient to account for the phenomena? It is admitted that the removal of the Gulf-stream would lower the temperature of Western Europe, which is now decidedly higher than might naturally be expected from its latitude. But for glaciation two factors are necessary—a low temperature and abundant atmospheric precipitation. Were the Gulf-stream suspended it is extremely probable that the quantity of rain, mist, and snow experienced in Britain, Holland, Denmark, Norway, and Sweden would decrease. Further, we have to account not merely for glaciation in Europe, but in North America, where it appears to have been, if anything, more severe than in the eastern continent, and in the southern hemisphere, where it has been traced as far as 3° south latitude. It is exceedingly improbable that the arrest of the Gulf-stream, or of any analogous current, should induce glaciation in Nicaragua and at Pernambuco.

It is scarcely conceivable that the Gulf-stream could retain for many thousands of years a circular motion imparted to it by an island no longer in being.

We come to the testimony of the Flora and Fauna. Mr. Donnelly points to the identity of the Palæarctic and Nearctic forms as an important piece of evidence in his favour. Admitting their close approximation,—which, indeed, leads some authorities to include these two great regions under one,—we must remark that it extends chiefly to the more boreal forms. A land-connection between the two continents in the genial latitudes of the Azores, Madeira, and the

Canaries, can scarcely serve to explain the presence of the reindeer, the musk-ox, the glutton, the lemming, &c., on both sides of the ocean. If, again, we compare the Fauna and the Flora of Africa with those of the Neotropical region, we find the most total contrast. This is not what we should expect if, as Mr. Donnelly holds, there was a land-communication between West Africa and South America or the West Indies. Whereas if, as is commonly done, we suppose animal life to have taken its origin in the Arctic region, as the part of the earth which first became sufficiently cool to be habitable and to have gradually extended southwards, becoming modified on its way, we should have, as may be seen, great similarity in the boreal regions, gradually passing southwards into extreme diversity. That a land-connection between Europe and America may have existed down to a comparatively recent period is regarded by geologists as not improbable. But the evidence at command places it much farther north than the supposed site of Atlantis.

An unfavourable piece of evidence may be drawn from the Fauna of the Azores. These islands, if Mr. Donnelly is in the right, must be remnants of Atlantis. Yet their animal population has nothing of a continental character, but seems formed of such waifs and strays as have been driven there by stress of weather.

Mr. Donnelly refers, in more than one part of his book, to cultivated plants as being either of unknown source or as being common to both hemispheres, and draws hence the scarcely legitimate conclusion that they must have originated in Atlantis, and have been introduced into other regions by the people of that empire in their commercial or military expeditions. As their empire, according to a map here given, included the coasts of India as far as the Ganges, Persia, Arabia, Egypt, and Nubia, on the one hand, and Mexico, the Valley of the Amazon, and Peru on the other, we may ask, How is it that they did not introduce the cultivation of sugar, tea, coffee, silk, and jute into their western possessions, and that of cocoa and cochineal into Africa and India? Yet these tasks were left for a much later age. The author asks, "Does Plato, speaking of fruits having a hard rind affording drinks and meat and ointments, refer to the cocoa-nut?" It is not impossible that he may have met with the cocoa-nut imported from India or the Eastern islands. We should think that its origin must be sought in the latter rather than in America. Be this as it may, there is no fruit so likely to spread without human agency as the cocoa-nut. It grows by preference on the sea-coasts; it survives long immersion in water, and is not unfrequently washed ashore at places far distant from the lands of its growth. The mango, according to the most recent authorities, is a native of the Malay Archipelago, and has only been acclimatised in Continental India and in South America. One point we must here bring especially forward: it is said that the fruits which man enjoys are artificial products which have been slowly developed under the influence of cultivation. But the Malay Islands are remarkably rich in exquisite fruits, which are for the most part incapable of being acclimatised elsewhere. Might not this fact be held to prove that there, in the "Gardens of the Sun," is the earliest home of civilisation. It must be noted that Mr. Donnelly argues at some length, and with much force, against the supposition of a former land-connection between North America and North-eastern Asia, but on the possibility of animals and plants being introduced into South America across the Pacific he is silent.

He is inclined to seek the origin of our domestic animals in Atlantis, and he affirms that no wild species has been tamed during the historical ages, *i.e.*, the last 7000 years. We doubt whether much importance can attach to this observation, even if correct. The number of animals eligible for domesticity is not unlimited. But we may well question whether Atlantis could possibly be either the original home of the elephant or the place where he was first tamed. Palæontology teaches us that South-eastern Asia was the seat of the Elephantidæ. All historical accounts agree that this animal was first used in war in India, and that its employment spread gradually to Western Asia, North Africa, and Europe. The ass, in like manner, is due not to Atlantis, but in all probability to Africa, where certain closely allied forms exist in a wild state. The cat is also an African species, and her domestication has evidently spread into Europe not eastwards, but westwards.

The question here arises, why, if the aboriginal civilisations of America are of the same origin as those of the Eastern hemisphere, were the former devoid of the services of domestic animals? The horse, ass, cow, sheep, goat, and hog were evidently unknown in America at the time of the first Spanish settlements. Now, if these creatures were first tamed in Atlantis, why did not that empire, with all its commerce, navigation, and enterprise, introduce them into its American colonies?

With the historical, mythological, and linguistic evidence accumulated by Mr. Donnelly we cannot deal in full. We must confine ourselves to discussing certain statements which are at issue either with known facts or with each other. We read on page 28 :—"Attention may here be called to the extraordinary number of instances in which allusion is made in the Old Testament to the 'islands of the sea,' especially in Isaiah and Ezekiel. What had an inland people like the Jews to do with seas and islands? Did these references grow out of vague traditions linking their race with islands in the sea?" Surely the Jews cannot be called an inland people, and since the maritime expeditions of Solomon they could not be altogether ignorant of islands.

On page 265 we read that the Egyptians had a horror of the sea, whilst on page 3 we are told of their circumnavigation of Africa, and on page 243 of a naval battle gained by Rhamses III., in the thirteenth century before our era, against a people called Tokhari.

Concerning the primitive religion of mankind Mr. Donnelly states (page 285) that we find a great Solar or Nature worship in the older nations. But on page 293 this is changed. We are told that "Men first worship stones, then other men, then spirits." Sun-worship here has disappeared. On the same page it is asserted that "Resemblances of names prove nothing." Yet resemblances of names are again and again appealed to, even when so slight as that between Olympus and Atlantis.

Concerning the Deluge of tradition we find on page 94 that "Egypt does not contain a single allusion to the flood." Turning to page 67 we meet with a very dissimilar account: —"The priests of Sais told Solon that before 'the great deluge of all' Athens possessed a noble race, &c. . . . So that the Egyptians, who possessed the memory of many partial deluges, regarded this as the great deluge of all.

On page 246 the Atlanteans are described as "a great maritime and commercial people, who carried vast quantities of copper, *tin*, and bronze (unalloyed by the lead of the South of Europe) to Denmark, Norway, Sweden, Ireland, *England*, France, Spain, Switzerland, and Italy." . . . . "Thousands of tons of copper and tin must have been introduced from Atlantis during the Bronze Ages into Europe." It is sufficiently bold to state thus the mineral wealth of a country which, if it ever existed, has been submerged for thousands of years. To proceed :—"There are no ancient works to indicate that the tin-mines of Cornwall were worked for any length of time in the early days." But on page 478 we read :—"In its markets (*i.e.*, Atlantis) must have met . . . . the *tin* of Wales and *Cornwall*, the *bronze* of *Iberia*." It is not needful to point out how these two passages contradict each other.

The empire of Atlantis, as figured in a map opposite page 294, seems to have been put together on the principle of eschewing "scientific frontiers." In Asia it included the coasts of India from the Ganges westwards, the coasts of Arabia and Persia, the whole of Asiatic Turkey, and the regions around the Caspian and the Sea of Aral, extending eastwards nearly to the frontiers of China proper, but leaving Thibet, much of Affghanistan, and Northern India untouched. In Europe the Atlanteans held the coasts of the Mediterranean, the whole of Spain, Italy, and Greece, much of Austria and Switzerland, the South of Russia, the coasts of France, the shores of the Baltic, the southern half of Sweden and Norway, and the British Islands. There remained unconquered a wedge of land narrow in the centre of France, and getting broader through Germany, Poland, and North Russia. In Africa they held the Valley of the Nile, the shores of the Red Sea, the Mediterranean, and the Atlantic down nearly to the Gold Coast. In America their dominions were strangely grouped. Neglecting the very near and accessible Atlantic coast and the West Indian Islands, they occupied the whole of Central America and Mexico, the Valley of the Mississippi and its affluents, the southern shore of the Canadian lakes, and a line of country leading over the Rocky Mountains to British Columbia. In South America they avoided the entire northern and eastern coasts, but passing up the Amazon they overran the whole of its valley, and crossing over the Andes settled in Peru, Bolivia, and Chili! Never surely was a vast empire formed with such disregard of accessibility, desirability, and defence. Mr. Donnelly says that they avoided the "fever-stricken lowlands of Brazil." But, on his showing, they settled on the *more* fever-stricken coasts of West Africa, and in the *tierras calientes* of Mexico!

Of these colonies Egypt is said to be the oldest, and hence to have acquired most of the civilisation of the mother country. This is, in itself, exceedingly improbable. The first attempts of any country in colonisation are generally made in the nearest available places. The Greeks colonised Southern Italy; the Tyrians, Northern Africa; the Carthaginians, Spain; &c. Had the Atlanteans proceeded on this natural principle their earliest settlements would have sprung up in Spain, Portugal, and Morocco. But Mr. Donnelly could not shut his eyes to the manifest truth that in the basin of the Mediterranean civilisation has proceeded from the east to the west. To account for this undeniable fact he is obliged to establish a colony of his Atlanteans in Egypt before they had attempted to subdue regions much nearer to their own country.

It will not be forgotten that he in his map includes the whole of Greece and the West of Asia within the Atlantean empire. But according to Plato's *Timæus*, in a document which Mr. Donnelly regards as historically authentic, and upon which he builds no small part of his argument, the Atlanteans had conquered Africa only up to Egypt, and Europe up to Tyrrhenia (*i.e.*, Tuscany). Then making a grand attempt to subjugate Egypt and Greece, they were finally defeated by the Athenians, and stripped of all their dominions in the Mediterranean. If this narrative, then, be authentic, Egypt can never have been an Atlantean colony.

The author's assumption that civilisation radiated outwards from the Mediterranean is not in all cases admissible. In Egypt it appears to have descended the Nile. We cannot carry further our survey of the speculations contained in this extraordinary work. But whilst holding that Mr. Donnelly has not made his case good, and that he relies too much upon that dangerous form of argument which may be generalised in the terms " Why may not A be X ?" we yet think that he has raised a number of most interesting questions, especially in Ethnology. These, competent inquirers will find every way worthy of their attention.

III. A NEW THEORY CONCERNING THE BURNING MOUNTAINS.

By A. H. Swinton.

It is interesting to note that the late prevalence of solar spots has inaugurated another eruption of historical Etna. The last period of eruption was in evident connection with the clearness of the solar disk in 1878, and the present statistics will eventually prove to stand similarly in connection with its spottiness in 1882. Often the periods of spots and no spots bring us to combined outbreaks from Etna and Vesuvius; it was so in 1689, 1694, 1723, 1755, 1759, 1783, 1787, 1805, 1809, 1832, 1845, 1868, 1876; and, as a rule, the eruptions from these and other burning mountains—Hecla, for example—will be found to cluster about the opposite solar phases that tread quickly on one another's heels, so that the cry of distress arising from the excessive summer rains still vibrates on the ear now winter has commenced to deluge the arable land.

Some consider that the winter season, the equinoxes, or summer solstice, and the full and new moon influence these paroxysms of the mountains. Prof. Silvestri telegraphs to the "Daily News" correspondent concerning the recent eruption of Etna:—"The coincidence with the full moon on March 23rd is again remarkable." Mr. B. G. Jenkins, in a letter to the same newspaper a year or two ago, observes—"If the movements of the lava in Vesuvius may be taken as an indication of what is going on in the interior of the earth, then the liquid fire within the globe must ebb and flow like the liquid ocean without, for the volcano, as your Naples correspondent has frequently observed, shows during its eruptions very many indications that the activity of the lava depends on the position of the moon." Certain members of the British Association—the names of Darwin and of Sir William Thompson of the Glasgow University occur to mind—have worked on these assumptions, and endeavoured to detect the existence of lunar vibrations with delicate seismographs, undaunted by the witticism that perchance they were keeping unconscious register of the local traffic. It must, however, be borne in mind that the statistics that originated this lunar theory were never unexceptional. Mr. Mallet, in introducing the subject to the notice of the Association, in 1859, remarked—"M. Alexis Perrey has thus succeeded, by the simple analysis of catalogues which he had previously drawn up, in proving, by three different and independent methods, the influence which the moon possesses in the production of earthquakes: first, that earthquakes occur more frequently at the Syzygies; secondly, that their frequency increases at the perigee and diminishes at the apogee of the moon; thirdly, that the shocks of earthquake are more frequent when the moon is near the meridian than when she is 90 degrees away from it." But Mr. Mallet added—"The numerical tables from which these three propositions are derived present some anomalies; and the author has omitted nothing to endeavour to account for them, and to prove the law which is revealed at their first inspection."

Passing from the influence of the moon to the certain potency of seasons, we have yet something that needs clearing up. Mr. Mallet shows that with regard to earthquake shocks we have in the Northern Hemisphere, broadly speaking, a minimum of shocks in May, June, and the early part of July, and still fewer during September. Most shocks indubitably come in January, and many in August and October. Further, there are more shocks at the critical epochs of the year, the equinoxes and solstices. Here we might pause and enquire whether this lateral push, that throws the earth's surface into rolling billows, may not arise from heat expanding or cold contracting its surface; for what do we understand by the seasons but an increase or decrease of warmth? But it will be said, if the shocks that occur in winter preponderate over those which happen during the summer season, it must be cold, not warmth, that heaves the soil and vexes and pinches the fuelled entrails of the Typhœan monster that sleeps beneath the volcano. I had fancied so until the following solution of the paradox suggested itself:—

A little thought will convince anyone that the march of climate does not wholly depend on the progress of the sun north and south; we have an influx of cold or spells of warmth at every season of various duration. The fickle ice of winter may at any time break up, and cold shivering days and weeks arrive in June; more than this, the very tissue of the seasons is wove of such alternations, and Italy, no less than storm-swept England, is victimised by them. A sojourner at Naples, where the spring air is conceived to be ever balmy and delicate, thus writes on the 17th of last March :—" Long before it is time for the primrose to spread its petals, we have, at the very first sign of spring, not only the daffodil, but troops of bright oxalis, making sunshine on every green bank; then follow the sweet-scented violets, anemones, white starwort and composite flowers, that gladden the many-clefted hills of the Vomero and Posilipo. Balmy breezes fan our cheeks, and little birds flit twittering from tree to tree. All this delight we have already enjoyed is just now interrupted by the vagaries of mad March, who has turned the upper half of Vesuvius into a sugar-cone."

Climatic changes in Italy are most felt in the plains of Lombardy, which bear much the same relation in that respect to the central and southern portion of the Peninsula that Scotland does to the South of England. To these variations of temperature Prof. D. Ragona, Director of the Royal Observatory at Modena, has lately directed attention in a paper, " Sur les Périodes Annuelles de Chaud et de

Froid," published in the Transactions of the Association Française for 1881. The following is his method of establishing the periodical recurrence of the changes :—He first plots off the daily mean temperature of twenty years' observation, and draws a curve to represent the annual march of the temperature, increasing from January 10th until July 29th, and then decreasing. It thus is rendered manifest that the mean temperature rises and falls as compared with this smooth curve of hot and cold resulting from the advance and retreat of the sun, and that these rises and falls of temperature, broadly speaking, have a tendency to recur at the same times of the year.

Having the dates of some hundred eruptions of Etna and Vesuvius by me, I bethought me to compare them with the warm and cold periods of the year as determined by Prof. Ragona. Since, according to Messrs. Mallet and Perrey, we have more earthquake shocks during the winter than in summer, I fancied, as I previously intimated, to see the dates tally with the cold periods, whereas what was my surprise to see them all huddled together at the warm ones? I therefore transposed M. Ragona's two tables, so as to show the warm periods of the year only at Modena, and then compared them with one another and with my chronicle of eruptions, and I discovered a certainly general concordance. The following were my conclusions :—A period of warmth attended with increased activity on the part of Vesuvius or Etna may be looked for about January 8th, of a few days' duration; and another following the 20th of the month, terminating about February 8th. The next may be expected about February 12th, lasting until March 16th; followed by another commencing on March 21st, and continuing until April 6th. The next may be expected about April 24th, and the next at the commencement of May, the last indicating about two weeks of volcanic activity, followed by a pause, and then renewed activity about the 24th, continuing until the end of the month, or protracted into the first two weeks of June. Another period of warmth and volcanic activity may be expected to set in about June 20th, lasting some four or eight days. The week following July 11th may be expected to be one of warmth and volcanic activity, and likewise the two weeks following the 26th. Another period may be looked for about August 11th, lasting for about two weeks, and another the first week in September. The week following September 20th and the week following October 10th are marked by eruptions, and correspond to, but hardly coincide with, two periods of warmth in M. Ragona's first computation, as may be said of a period of activity coming the first or second week in November. From December 1st until January 2nd volcanic activity seems to know but little respite, although it seems probable that outbreaks have arrived more frequently during the week following the 24th and about the 30th of the month.

If we now recal to mind the eruption of Etna just transpired, it might be an open question whether we should refer it to the influence of the full moon or to an influx of warm temperature. It will be remembered that the full moon arrived on March 23rd, and that the eruption began on March 20th and continued until April 4th. According to M. Ragona's second table a period of warmth should have been likewise looked for in Italy, beginning on March 20th and ending April 11th ; and, according to his first table, two periods of warmth should have come about this time,—one from March 27th to 29th, and another from March 31st until April 17th. Theoretically, his first table would with great probability assign the increase of warmth as the cause of the eruption ; but it must be remarked that, in this country, warm days did not set in until March 30th, and they terminated on April 6th, when the temperature in the shade fell, so that the eruption preceded the temperature change by nine days. The state of matters at Catania I am unable to divine : on March 21st it was reported in the newspapers that great cold prevailed there, and that the sky was cloudy, but when the change was first felt I do not know.

On the whole I think statistics show that the eruptions of Etna and Vesuvius come most frequently at the winter solstice, or about December 21st ; at the vernal equinox, or about March 20th ; and somewhat less frequently at the summer solstice, or about June 21st : there are fewer in July, and about the autumnal equinox, or September 22nd, they are again frequent. Apart from the anomaly of the paucity of eruptions in July, these dates will be found indicated as warmer periods in the several seasons. As a corollary one might ask, Are thermometer fluctuations greater at the periods of sun-spots and no sun-spots when seismic activity is most violent ?

IV. WEALTH AS AN ELIMINATIVE AGENT.

By W. Mattieu Williams.

THE concluding part of the article on "Vice as an Eliminative Agent," in the last number of the "Journal of Science," is very suggestive. The writer says that the commercial scoundrel "robs not by crying 'Stand and deliver!' but by rigging the market. He belongs not to a gang, but to a syndicate, and when he has done more harm than a generation of bandits, burglars, or forgers, he dies in peace, and leaves his children in good positions."

Query—Are the positions of his children really good? Is the ill-gotten wealth with which he endows them likely to fit them for holding their ground in the general struggle for existence? Or may it be an effectual agent in exterminating the foul brood?

We must remember that the man who lives a life of vigorous commercial rascality, and is married to a woman of his own type, will transmit to his offspring a vigorous and vicious organisation. If his domestic partner is quite different, an alternation of type among his children will be the probable result, some resembling the father, others the mother.

What is the effect of the possession of unearned wealth upon young men with vicious predispositions? It is simply a weapon of "happy despatch," which operates by supplying abundant means of sensual self-indulgence. Given two young men with low animal organisation, and equal physical vigour and bodily health,—one a navvy or farm labourer, the other inheriting sundry thousands a year on coming of age,—which is likely to live the longer and leave the larger family? Anybody who has had opportunity of watching the career of representatives of these two classes can answer this question at once.

Only a small minority of human beings are benefited by inheriting large accumulations of wealth. An exceptional organisation is necessary to enable a young man to escape the temptations and physical excesses which the early inheritance of great wealth supplies. This is indicated by the degeneration and dying out of all aristocracies that are not continually recruited from the useful classes. The law is strikingly illustrated by our own race. While the working

Anglo-Saxon is crowding himself out from his old home, and overspreading the earth, the British peers—in spite of all their efforts to drag collateral branches into their titles, &c.—are utterly incapable of maintaining their numbers in the House of Lords, which would long ago have been reduced to a little camarilla of curiosities had it been dependent on the survival of the original stock.

An idle aristocracy bears the same relation to the general working members of the race that poodles and other lap-dogs do to bulldogs, collies, terriers, &c. The lap-dog is a canine aristocrat, supplied without effort with a redundance of physical luxury, and he perishes without the aid of any exterminating outside enemy. This is shown by the resemblance of King Charles's spaniels, &c., to our peers of the realm. In spite of the demand for these fancy animals, indicated by their high price, the maintenance of the breed is a matter of great difficulty.

I have noticed a curious physical resemblance between them which is very suggestive. The general laxity of fibre in the petted spaniels and poodles of "pure breed," *i.e.*, with blue blood, is indicated by the protrusion of the tongue, owing doubtless to lack of muscular tension. The Dundreary lisp that really does prevail among their biped analogues (though not to the extent represented by their caricaturists) is evidently due to a similar falling forward of the tongue. The simple experiment of imitating this defect of articulation will show that it is caused by a protrusion of the tongue, in such wise that its point languidly strikes the teeth when it should vigorously press against the palate.

A visit to the House of Lords, and careful observation of the tones of voice, the gait, the lolling on cushion, the nonchalance, and other movements of the surviving representatives of ancient aristocratic families, will supply further evidences of the analogy above named.

My own observations (so far as they go, but this is not very far) on the *moral* characteristics of the survivors of a long-sustained aristocratic line indicate in this respect a very high type, shown by lofty forehead, high coronal region, and that polished and true courtesy due to genuine regard for the feelings of others which presupposes the easy suppression of passionate impulse and self-assertion. These I find to be combined with simplicity of taste, and very moderate indulgence in eating and drinking.

Other characteristics that might be named further indicate that, in the struggle with the terrible temptations presented by their surroundings, the grosser animal specimens, the more passionate and sensual, have succumbed, while only those of a higher moral type have been able to survive; but even their survival has been limited by the absence of those motives to physical and mental effort which have fed the energies of their more favourably situated fellow-countrymen.

The *working* politicians among our aristocracy, and the very exceptional few who have distinguished themselves by earnest scientific or literary labour, are of course exceptions to the above. These have reverted to the natural conditions of vigorous human development, conditions enforced upon the mass of mankind by the fact that our food does not grow ready cooked at our feet, nor our clothing on our backs.

Modern Royal families, in constitutional countries like ours, have such heavy social duties, and responsibilities and restraints forced upon them, that they may be fairly included among the "working classes."

V. THE ACTION OF POISONS ON THE PETALS OF FLOWERS.

By A. Anthony Nesbit, F.C.S.

Continued from Vol. IV., p. 743.

Alcohols employed: Ethylic, Propylic, Allylic, and Amylic.

ALL these extracted the chlorophyll from the stems of the plants, but in varying quantity. Propyl, allyl, and ethyl alcohols extract a large quantity, and amylic very little. Propyl, allyl, and amyl alcohols are far more destructive to the life of the flower than ethyl alcohol. The flowers in these alcohols would show signs of fading in an hour and a half, whilst those in ethyl alcohol would remain quite healthy six or eight hours.

When ethyl alcohol was diluted its action on the flowers became less. If diluted from one to three, or from one to five, the flowers after twenty-four hours' immersion would be but little more faded than those which were kept in water only, and if diluted down to one to ten the flowers would remain about the same time as those in water.

Action of Boric and Salicylic Acids.

Solutions ranging from 1 to ¼ per cent of crystalline acids were used. Salicylic acid always discoloured the stems, whilst boric acid did not. All the flowers in salicylic acid were much more withered after twenty-four hours than those in water alone. All the flowers in boric acid were withered more than those in water, but not so much as those in salicylic acid.

Acids and Alkalies.

The following solutions were used, *viz.*, normal carbonate of soda, normal potash, and normal sulphuric acid. All the flowers were withered after some time, one as much as another. The stems of those in acid were discoloured; those in alkalies were not.

Action of Mineral Salts.

Salts which caused the Stems to turn Brown.

Copper sulphate.
Mercuric chloride.
Potassium sulphocyanide.
Ferric chloride.
Ferrous sulphate.

Salts which had no effect on the Stems.

Lead acetate.
Sodic arseniate.
Potassium chromate.
,, bichromate.
,, ferrocyanide.
,, ferricyanide.
Sodium sulphite.
Zinc sulphate.
Barium chloride.
Strontium nitrate.
Permanganate of potash.
Oxalate of ammonia.

Salts which coloured the Flowers.

Potassium chromate.
,, bichromate.
,, ferrocyanide.
,, ferricyanide.
Ferrous sulphate.
Ferric chloride.
Copper sulphate.
Potash alum.

Salts which did not colour the Flowers.

Potassium permanganate.

And all those salts which form a colourless solution with water, with the exception of potash alum and other salts of alumina.

Potassium chromate and bichromate are about equal in their action on sweet peas. Both colour the petals strongly.

Ferrocyanide and ferricyanide of potassium are equal in their action, and do not differ appreciably in destructiveness from the chromate and bichromate. Both colour the petals, the tint being the same in both.

Cyanide and sulphocyanide of potassium do not differ one from another with regard to their action on sweet peas, but are more hurtful than the chromates and ferrocyanides.

The salts of iron seem very hurtful to the life of sweet peas, more especially the protosulphate of iron. Both colour the petals, the colour being brownish black. The ferrous sulphate colours the petals more strongly than the ferric, and kills the flowers sooner.

Strontium nitrate and barium chloride are less hurtful than the chromates; the ferro-cyanides and the cyanides also much less hurtful than salts of iron and zinc.

Oxalate of ammonia is more destructive to sweet peas than sulphate of zinc or sulphite of soda.

Of copper sulphate, mercuric chloride, arseniate of soda, and acetate of lead, the least hurtful is mercuric chloride, the flowers remaining quite fresh for eight hours sometimes. Arseniate of soda is the least hurtful, while lead acetate and copper sulphate seemed to be equal in their effect and less hurtful than arseniate of soda.

VI. HAECKEL, HUXLEY, AND MIVART ON THE SCOPE AND PROVINCES OF ZOOLOGY.

By Oswald Dawson.

PROFESSOR HAECKEL, in a volume recently contributed to the International Library of Science and Freethought, appends to an address delivered at Jena University in 1869, and thrice published in Germany since that year, a table illustrating the scope of zoology which contains several words differing from, or foreign to, those employed in the terminologies adopted in this country. In some half-dozen points this table further differs from that given in the author's "Generelle Morphologie" in 1866. The word "œcology" is common to both; it is also defined in the "History of Creation" and in the "Evolution of Man," and thus has claim to familiarity, though Professor Karl Semper, who undertook an examination of "Haeckelism" some time ago, and contributed to the "International Scientific Series" a volume purely œcological, ignores the word, employing in its stead the cumbersome phrases "Universal Physiology" and "Physiology of Organisms." The difference in the two terms lies in this: Professor Semper's "Physiology of Organisms" embraces dispersal, but seemingly not Chorology. Professor Haeckel's Chorology embraces dispersal, though his definition of œcology entitles it to include the latter. It runs as follows (*vide* the address):—"By œcology we mean the study of the œconomy, the housekeeping of animal organisms. This has to do with the totality of the relations of the animal, both to its inorganic and organic surroundings, and, above all, the amicable and inimical relations to those animals and plants with which it comes into direct or indirect contact: in a word, all those complex mutual relationships that Darwin has shown are the conditions of the struggle for existence." In the "History of Creation," œcology is stated to concern "especially the circumstances of parasitism, &c." Why should œcology concern *especially* the relations of living beings to *organic* surroundings? In his Stettin address, not less historical than those delivered at Munich and Eisenach, Professor Haeckel said in 1863 (*vide* p. 25) "Many gaps and weak places in the growing edifice give large opportunity to the attack of foes. On the other hand, many circumstances are still altogether, or almost altogether, unknown to us that are possibly of no less moment in the origin of species than Natural Selection in the struggle for existence, on which overstress is, perhaps, laid by Darwin. *No less important* than these must be those external conditions of existence *of the inorganic world* that are too much neglected by Darwin;" or to utilise the analogy, it may be a *housekeeper's* business to be affable to visitors and hostile to burglars, but not "especially" so—not more so than to prevent a perpetual draught invading a much-frequented passage or speedily to renovate disordered drains. Œcology, therefore, includes the relation of animals and plants to the wind and other "means of dispersal." Profitable as it may be for original workers to read chorological facts in the light of œcological and physiographical speculations, that union cannot with propriety extend to a tabulation of the provinces of zoology. The African deputation of *Polypterus* may incite to a little speculation as to the "how," for can it be declared that the *Polypterus* of the Senegal and of the Upper Nile are independently originated by homoplastic agencies when we reflect on the extensive similarity of the piscine fauna of the Upper Nile and West Africa? Yet the comparative chorology of the Dipnoi and Osteoglossidæ (*vide* "Study of Fish," p. 223) is a topic surely worthy of being discussed without reference to physiographical changes or the œcology of dispersal. "Distribution" and "œtiology" share the last chapter of Professor Huxley's "The Crayfish." It is divided into nine sections, of which the first six treat of distribution, *diffusion not being here discussed, consequently Professor Haeckel's "Perilogy" and its competitor, Dr. Mivart's "Hexicology"* (terms affiliating the study of environment generally and therefore of dispersal, to Chorology), *are not needed.*

Professor Haeckel and Dr. Mivart employ two other rival words. The footnote to page 2 of "The Cat" runs thus:—"The word Psychology is here used in its wide and (as the author believes) in its proper sense as embracing Physiology within its scope," and Chapter xi., §§, 5 17, demonstrates that Dr. Mivart means what he says. Professor Haeckel's new word "Ergology" comprises Physiology and Psychology. The "Physiology" of "The Crayfish" enters the realm of "Psychology." Dr. Letourneau, contributing the volume "Biology" to the Library of Contemporary Science, states:—"Under the designation 'Biology' we merely place the exposition and the co-ordination of all the great facts and great laws of life, or nearly what is usually understood by "General Physiology," when this denomination is applied to the two organic kingdoms. In this volume we have simply attempted to state concisely what life is, and how organised beings are nourished, grow, are reproduced, move, feel, and think." We thus have a choice of four words—Biology, Physiology, Psychology, and Ergology, the adoption of any one of which means that splenic undulations and *felo de se* fall within the same province; the study of innervation, reflex action, consciousness, &c., furnishing a series of gradations from the one to the other. Notwithstanding, some may be disposed to adopt Physiology and Psychology as primary and co-equal provinces, a procedure sufficiently pardonable to deserve refutation here. Omitting for the moment the question of consciousness (which may belong to "*metaphysics*"), under which province are the various other subtle forces pervading organisms to be ranked? to specify a few. There are the properties with which the late Mr. Darwin's renowned Pangenesis Gemmules are endowed; there is the "kind of infection" which prompts a bone to go "out of its way, so to speak, to become cartilaginous before being ossified" ("Balfour," vol. ii., p. 494), and the analogous influence by which Professor H. G. Seeley would explain the multiplicity of mandibulan ossifications (*vide* "History of the Skull," King's College (London) Scientific Society, 1882); finally there is the *psyche* itself, the *psyche* of "*the* philosophy of *the* philosopher," according to Dr. Mivart, which, as embellished by that philosopher, proves to be the agent employed by the Creator, who, making use of living organisms as means," evolves "new concrete forms" by a process so subtle that "we cannot imagine how they are produced;" the *psyche* at once the antagonist of natural selection, pangenesis, perigenesis, dramatic and fictitious sensationalism; the veritable *psyche*, which "there is no adequate reason for believing" to be other than identical with the *psyche* for whose survival of the dissolution of *man's* body, "there is good evidence of a philosophical kind."

In the "Evolution of Man," Table xxix., Prof. Haeckel names the central nervous system the *psyche*; the dorsal marrow, *noto-psyche*; the parts of the brain, proto-, deuto-, meso-, meta-, and epi-psyche, though, in the text, he names the "medulla capitis," *encephalon*. "Physiology" has a no less variable meaning than the *psyche*; it has an etymological claim to concern itself with all science; ordinarily it is synonymous with the "Institutes of Medicine"; according to Prof. Huxley ("Anat. Inv. Animals," p. 26, and "Ency. Brit.," 9th ed., article—"Biology"), it embraces œcology, which Prof. Semper entitles Universal *Physiology*, or the *Physiology* of Organisms; Dr. Mivart finds ("The Cat," p. 389) that phylogeny "may, by a remote analogy, be termed 'the *physiology* of the species'"; finally, in Prof. Haeckel's table, it includes the *physiology* of "soul-life" and of imagination, while chorology is embraced by the "*Physiology* of Relation. In the table in the "Generelle Morphologie," the physiology of relation (internal) is classed with what Prof. Haeckel now terms "Perilogy," while the physiology of nutrition and generation are classed together. In the new table, though Perilogy alone constitutes the physiology of relation, the physiology of sustentation and generation are still classed together, and only secondarily associated with the physiology of the animal functions. Dr. Mivart adopts this arrangement ("The Cat," p. 386); in

"The Crayfish"; reproduction and the physiology of the animal functions share the same chapter. "Splanchnology" is the name applied to the study of the structure and functions of the organs of sustentation and generation; neurology to the nervous system; in Table xxvi. of "The Evolution of Man," the muscular and skeletal system are classified together, though no designation, so far as I am aware, embraces the study of osteology and myology, nor unites them to splanchnology, thus bringing the intermediate position of neurology between these departments and "Psychology" into perspicuity.

Prof. Haeckel divides Biology into Zoology, Botany, and Protistics; therefore, when the ownership of a particular organism is a matter of contention between the zoologist and botanist, the creature remains a Protist until the fluctuations of taxonomical diagnostics afford an opportunity to relegate it to the custody of one or other of these investigators. By a somewhat analogous procedure, neurology, together with the study of the various subtle forces pervading organisms above specified, together with those of phrenologists and spiritualists, with any others which may be discovered, re-discovered, or invented, may be considered as occupying an intermediate position between the study of all body functions, save those of nerve on the one hand, and the study of intelligence on the other hand. Psychology *overlaps*, though, as Dr. Mivart insists, more strictly *includes* these studies. Nevertheless, for convenience sake, the entire *work* performed by an animal or plant, may be termed—as a briefer form of "Psychology in its wide sense"—"Ergology."

It is surprising to see "Anatomy" honoured in the table when one reflects upon Prof. Haeckel's remarks on the assumption of "zootomy" being anything other than a pure art; it happens the two words labour under a precisely equivalent etymological disqualification. It is under this subdivision that there occur four words foreign to the works so often quoted in this article. One of the four is defined in *Gegenbaur*; another one in *Macalister*, here possessing a different signification; one is misprinted "Cosmology," to the consternation of anyone not familiar with the proper word; one, "Blastology," is, I believe, the equivalent of the "Prosopology" of the table in the "Generelle Morphologie," and already pre-occupied for the study of the countenance; the definition of one subdivision is almost that of its parent —Anatomy being study of body-structure, and Tectology, study of structure. None of the four are given in the index, and not one of them explained or mentioned in the Address to which the Table is appended. Two secondary subdivisions occurring in the Table of the "Generelle Morphologie" are absent from their corresponding places here, while under Anatomy is placed, in brackets, "Comparative Anatomy." Prof. Haeckel's second subdivision of Morphology is of a kindred nature; ontogeny is defined as "history of embryo," a delusion long ago dispelled by Prof. Haeckel himself; metamorphosis (larval) is written instead of "Schadonology"; "Metamorphology," a term as unsuitable as "Promorphology," and occurring in the table in the "Generelle Morphologie," is here ignored, while "Anaplastology," "Metaplastology," and "Cataplastology" (defined "Gen. Morph.," band ii., s. 22), are likewise excluded; lastly, under Phylogeny are bracketted the three words,—Palæontology, Genealogy, and Classification.

We pass, without reluctance, to "The Crayfish," to analyse the morphological chapters therein. "The Crayfish" is, "in a sense, a house, with a great variety of rooms and offices" (p. 139). "That which architecture, as an art conversant with pure form, is to buildings, Morphology, as a science conversant with pure form, is to animals and plants" (p. 140). "The entire body of the animal, when reduced to its simplest morphological expression, may be represented as a cylinder, closed at each end, except so far as it is perforated by the alimentary apertures." A metamere is described, and remarks made with a view to exposing the teleological blush of serial homology (pp. 149, 174). Histology is treated, and also embryology; in fine, the animal is studied simply as if it were the work of an architect and his builder, *the analogy being complete.* We have cells and calcareous salts; we have the bricks and tiles; we have the organs, so the rooms; the antimeres, as exhibited in symmetrical houses; the metameres, as better illustrated by a row of houses; finally, we have the stereometry of organisms (*vide* "Gen. Morph.," band i., Buch iv., Tafeln. i., ii.), so we have the style and plan of the house. Prof. Huxley treats these topics apart from Comparative Morphology. This essentially *architectural morphology*, therefore, may appropriately be designated "Tectology." "Antimerology" and "Metamerology" (Table, "Gen. Morph.") link Promorphology (stereometry of organisms) to "Merologie" (study of parts, Bd. i., s. 25 and s. 29), this being an extremely valuable word.

Prof. Haeckel's elevation of ontogeny to the post of sole companion of phylogeny (in theory, though not in practice) is paralleled by Prof. Huxley's esteem for palæontology,—

"the only perfectly safe foundation for the doctrine of Evolution" ("Anat. Inv. Animals," p. 41). Those who wish to perceive the consequences of this belief may peruse the last section of the chapter on Comparative Morphology in "The Crayfish," and the chapter on Taxonomy in the "Anatomy of Invertebrated Animals." In the latter, after using such phrases as "the closest affinities," "specially modified anenterous *Nematoscolisces*," "no annectent forms between," "natural to suppose that the first process preceded the second in order of evolution," Prof. Huxley writes: "It is very important to remark that these morphological generalisations, so far as they are correctly made, are simple statements of fact, and have nothing to do with any speculations respecting the manner in which the invertebrated animals with which we are acquainted have come into existence. They will remain true, so far as they are true at all, even if it should be proved that every animal species has come into existence by itself and without reference to any other." Similarly, in "The Crayfish," we read of "degrees of affinity" and of "morphologically related," and are then told that "no amount of purely morphological evidence can suffice to prove that the forms of life have come into existence in one way rather than another." No; nor any amount of chorological evidence; nor if Prof. E. D. Cope lives to describe billions of fossils; nor if pigs begin to fly, and fishes forsake the sea, and every ape in the world invent a razor, shave, and serenade his mistress, will phylogeny (pre-historic) be *proved*. It may be very interesting to construct Taxonomies in the form of a Tree, to discourse on affinities and degenerated forms, and then to declare, "Oh, this means nothing; it is simply a mode of stating the truths of anatomy and embryology; wait till certain requisite fossils are discovered in certain strata, and *then* it will become a 'phylogeny'," but of the two evils I prefer dogmatism. Let an eternal barrier be placed between the two species of Taxonomy—"Phylogeny" and "Phylotecty." There is nothing derisive in this latter word; it simply expresses the phylotectist's adherence to the *architect* theory.

If the comments made in this article are unimpeachable, there are five primary provinces of Zoology (not given *in any particular order* below:—*Œcology*, or the study of the environment of an animal; *Ergology*, or the study of the *work* performed by an animal; *Chorology*, or the study of the distribution of animals; *Tectology*, or the study of the materials of which an animal is built, and of the plan upon which it is built; *Taxonomy*,[*] or the study of an animal's "place in Nature," which Taxonomy may be either "*Phylogeny*" or "*Phylotecty*."

In separating Œcology from Chorology, Prof. Huxley has been followed; in divorcing it from Physiology, Dr. Mivart; in dividing Ergology into three instead of two sub-provinces, justification is sought by referring to a more or less parallel classification of the departments of Biology by Professor Haeckel, namely, into Zoology, Protistics, and Botany, the sub-provinces of Ergology being—(i.) Physiology *minus* Neurology; (ii.) Psychology; (iii.) "Nousology" (?).[†] In deference to etymology and convenience, Tectology has been extended so as to embrace Promorphology, or the Stereometry of organisms: the word "Phylotecty" has been invented in antithesis to "Phylogeny," thus bestowing a *prestige* on the speculations of a school of teleologists whose consciousness of their philosophical and numerical jeopardy will not allow them to fail to appreciate the compliment. One point alone remains to be contested.

The last chapter of "The Cat" is devoted to a consideration of the "pedigree and origin" of that animal. Phylogeny concerns the former, no special designation is given to the study of the origin. The treatment of this latter commences thus:—"This second question refers, as before said, to the probable causes which have determined that process of evolution which has, in fact, taken place." No doubt this procedure is in accordance with Professor Haeckel's views. Professor Huxley has borrowed from the physicians the word "Œtiology," and this "œtiology" is no insignificant department of occasional value, but is one of the four primary provinces of the science. In the "Anatomy of Invertebrated Animals" under this section the topic of abiogenesis is discussed, three causes of variation specified, and phylogeny is defined. In "The Crayfish" under this heading, the creation and abiogenesis (of crayfishes) are discussed, or rather dismissed; also diffusion, changes in physical geography, distributional difficulties, fossil *Astacomorpha*, and the genealogy of crayfishes. In the article "Biology" in the "Encyclopædia Brittanica," also in the "Anatomy of Invertebrated Animals (p. 35), reference is made to "the attempt to found this branch of science made in the "Origin of Species." Many people will suppose that any further critical comment upon a word boasting so celebrated a patronage must be impertinent. Nevertheless, to test whether or no Professor Huxley is or is not exaggerating the scope of œtiology, as indicated in the "Origin of Species," cannot be deemed superfluous. The account which Mr. Darwin gave of the origin of species reminds one of that given by Moses, the chief difference lying in this: that while in the writings of the latter on creation we have an abrupt and discernible transition from the Elohistic to the Jeovistic document*, no such harmonious leap is manifest in the "Origin of Species." Mr. Darwin detected this, and accordingly declared that "this whole volume is one long argument." Professor Huxley described the "Origin of Species" as "a mass of facts crushed and pounded into shape, rather than held together by the ordinary medium of an obvious logical bond. "But Professor Huxley adds, "Due attention will, without doubt, discover this bond, but it is often hard to find" ("Lay Sermons," p. 257). The "Origin of Species" *is* an œtiology indeed. The sub-divisions of that department are blended in the most inextricable confusion, and with equal discriminations and modesty the doctrines of "descent with modification" and of "natural selection" are labelled "my" theory and "our" theory (pp. 291, 308, 310, 312, 344, 351, 359, 362, 375, 379). At other times we hear, with more propriety and equal indiscrimination, of "the" theory and "this" theory (pp. 265, 279, 286, 289, 313, 409, 429). Here choice is offered between the theories of creation and of natural selection (*vide* esp., p. 383); there between creation and descent. Criticism on the "Origin of Species," that is to say the body of the work, must be regarded as fundamentally distinct from complaints about the title. The "Origin of Species" is a legitimate term comprehensible to anyone who *will* take the trouble to recognise that it means the *furtherance* of variations, and not their *origin.* "Natural selection" is "justly and properly to be termed" thus (*vide* "Lessons from Nature;" by St. George Mivart, Ph.D., F.R.S., &c.; London, 1876, p. 290), *if* one can only grasp the conception that it is but a synonym for the "survival of the fittest" in the "struggle" for *existence*; but does history since 1859 tend to show that that is such an easy task? While even the "struggle" receives a little countenance *if* one will but promise to remember that it is used in "a large sense," "metaphorical sense," "a far-fetched sense," and "in these several senses," "for convenience' sake" (*sic*) (*vide* "Origin of Species," p. 50), but there is much virtue in an "if." But the applauder of Charles Darwin may attempt to demonstrate this to be a parade of cavilling by reminding us of the need of economy of space so often insisted upon in the "Origin of Species." He may plead that whenever Mr. Darwin speaks of "the theory of descent with modification," it is only from "sheer want of room" that he does not in *every* instance append the words "through variation and natural selection," as he does on pp. 313 and 404, and the applauder's position will be unassailable, for until Mr. Darwin's life and correspondence are published it is superfluous to attempt to decide whether we have to deal with a hypocrite or a simpleton.

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[*] "Taxonomy" would be better restricted to the actual tables of classification, save that we have no designation for the aggregate study of Comparative Merology, Embryology, &c.

[†] νους, contraction of νόος, talent, disposition; "νόος is sometimes used by Plato for the excercise of reason" (Pickering, and Dunbar—Lexicons); ἀνθρώπων νόος, the mood or temper of men (Liddell and Scott, abridged, 1852); νοοσφαλής, weak in mind, insane. *Nous.*—"This Greek word has become thoroughly naturalised" (T. Lewis O. Davies, "Suppl. English Glossary"). Given in "Imperial Dictionary," 1882. It occurs in "Peter Pindar, in the "Ingoldsby Legends," and in Hood's "Fairy Tale": νους, as reason (the faculty), universally used; νόησις, also a definition (C. D. Younge, "Eng.-Gk. Lex.," 1874). "The sum total of the mental action of a rational animal may be called its *noesis*" (St. George Mivart, "The Cat," p. 386). *Noesis* is given in *Mayne* as including *perception*. Thus both *nous* and *noesis* are borrowed without modification from the Greek, but the former is as familiar to the populace as is the study of *Comparative* anecdotal *Psychology* itself.

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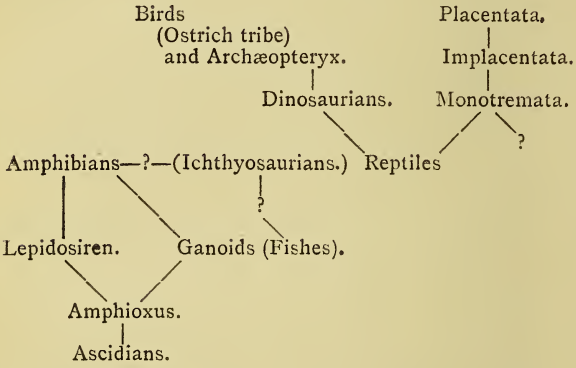
* Genesis: Its Authorship and Authenticity. By CHARLES BRADLAUGH. Part I. Third Edition. International Library of Science and Freethought (vol. iv.), 1882. *Vide* pp. 9-11; 93-95; 323-328.

Until a week or two ago I intended to here expose a few of the self-stultifications which the applauders of Mr. Darwin are so prone to exhibit, to comment, for instance, on the alleged courtesy to opponents, and justice to Mr. Alfred Russel Wallace, forsooth; but it occurred to me that the first-fruits of œtiology need no supplementary exposures. Let us therefore examine how far phylogeny and other divisions of "œtiology" harmonise together. Passing over Mr. Darwin's speculations on Abiogenesis, let us assume that, from the pedagogic stand-point at any rate, Phylogeny has priority to the other branches of "œtiology"; granted this, it is accordingly desirable to have *one or two* tolerably "dogmatic" genealogical trees. A Professor of Biology has recently made Mr. Darwin's death the occasion to repeat his convictiion that Prof. Haeckel's phylogenies are too positive. His remarks are immediately succeeded, in the same paragraph, by a sentence containing the words "Darwin's decisions so weighty." It is not stated that the latter expressed the opinion that Prof. Haeckel had "thus boldly made a great beginning"; that "he who wishes to see what ingenuity and knowledge can effect, may consult

Prof. Haeckel's works"; that, "as we have no written pedigrees, we are forced to trace community of descent by *resemblances of any kind.* Therefore we choose, &c."; that it is "almost impossible" to study phylogeny without "the aid of a genealogical tree"; and that Prof. Haeckel triumphantly cited Mr. Darwin's agreement with "the general outline of the genealogical tree," as given by himself ("Origin of Species," p. 381; "Descent of Man," p. 158; "Origin of Species," p. 372 and p. 379; "Evolution of Man," vol. i., pp. 103, 104). Consequently, for the benefit of those who approve of uniting phylogeny to the "œtiological" portions of œcology and psychology, I will construct the phylogeny of the *Chordata* from Mr. Darwin's chapter on Affinities and Genealogy. Indeed, it is "almost impossible" to avoid so doing; therefore, *vide* "Descent of Man," second edition, *revised* and augmented; preface dated September, 1874.



In fine, therefore, there seems reason to adhere to the method of Dr. Mivart in respect to the isolation of Phylogeny; œtiology being a science—"wheels within wheels," fit first-fruits of a book comparable to a "cogwheel" striving to articulate with a fellow wheel of smooth circumference. Of course the theory of natural selection is not affected by any considerations as to the knavery or naiveté of one of its propounders, or the self-stultifications of his applauders. Discussion on the latter may be, perhaps, outside the sphere of a Journal of Science, while the maturity or puerility of natural and sexual selection affect not even remotely the nomenclature, propriety, or the reverse, of the provinces of Zoology:—*Ergology*, *Tectology*, *Taxonomy* (provisionally), *Chorology*, and *Œcology*.

VII. NOTES ON THE MIAS.

By W. DE CRESPIGNY, of Sarawak.

TAILED men are even to this day occasionally mentioned in your Journal and considered to be (if found) a missing link between men and monkeys, the fact being lost sight of that the ape is a link between those two animals, and that the link sought should have no tail.*

While upon the subject of apes a few remarks on the mias (pr. *maias*), or orang utan, may be permitted. During my twenty-six years of life in the Malay Archipelago I have had many opportunities of studying them, although I have met with only one species. They live *in* the forest, among the branches of the trees, and very seldom come to earth. I have never seen one on earth alive and free, and believe they only come down when progress aloft is impracticable, owing to the distance between the branches of neighbouring trees happening to be too great; and this in the forests of Borneo is *very* seldom the case, for the trees grow as close as Nature will allow them to. They live on fruit. They form families of male, female, and infant; and I have seen not only one infant, but also that of the previous year included in the group. They make nests in the fork of the tree, or in the fork of a branch of it, of transverse pieces of stick, but they do not thatch them, as some suppose, although they do bestrew the interior with leaves. The female and infant sleep in this nest, the male higher up. The nests are occupied only for a few days; that is, until the fruit in the immediate neighbourhood is consumed, when they move on. The arms of the orang utan (men of the forest, if both words are considered as substantives; wild men, if utan is used as an adjective, which it seldom is) being very much longer than its legs, it trusts mostly to them for its powers of locomotion; and I need scarcely add to what has gone before that the picture of a maias (or its skeleton) as represented in the Natural History portion of the "English Cyclopædia," where the animal is represented to be walking upright on its feet with the aid of a staff in its hand, is misleading. I have read that once when a maias was killed, which was destitute of thumb-nails, it was considered as belonging to another species. This is not so, but the thumb-nails become obliterated as the animal increases in age, owing to its continual travels through the forest, and the constant use they are put to in tearing open obdurate, because unripe, fruit. I have seen many men in Borneo whose nails, in consequence of life and work in the forest,—such as searching for gutta, ratans, and edible nests,—have become almost obliterated.

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* We have repeatedly pointed out that the anthropoid apes are as tailless as man. The instances of tailed human beings we regard merely as reversions. —ED.

The pouch or drum under the chin is, I take it, not a drum, but really a pouch, or, as the sailors call a similar process in monkeys, a "panam bag," or receptacle for storage of food not required for immediate use. True I have never found food in this pouch, but, on the other hand, I have never heard the maias roar. While it happens that the maias has really no outward nose at all, only noses for nostrils, the exquisite shape of the ear—which we justly consider unsightly and useless as regards ourselves—really attracts the attention as an object of beauty. The large males, although weighing twice as much as a full-grown man, have no larger genitals than a human child of tender age.

The largest maias I have killed measured 8 feet 10 inches in the stretch, being 12 inches longer than Mr. Wallace's largest. This monster was in the prime of life, having his teeth and nails unimpaired. The breadth of his face, including callosities, was 13 inches. I sent the skin and skeleton to Mr. Higgins, of Bloomsbury Street.

The infant maias, when taken, at once accommodates itself to circumstances, showing no fear of its captor, but looking to him quite naturally as its protector and feeder. If cold it will at once use a handkerchief, or even a piece of newspaper, as a cloak.

In the "Life of Apollonius" we read that in the distant East there is a country where pepper was cultivated, and the farmer employed apes to cultivate the vines. Now pepper has been from the most ancient times cultivated in Sumatra and Borneo, and the maias is found in each of these countries. The same work, however, makes mention of an exceedingly high mountain. Although we have Mount Ophir in Sumatra, it is not very remarkable, as it is *apparently* only the highest part of a long range. But in Borneo we have Kinabalu, much higher than Ophir, and, from the sea, apparently a detached mountain, and so more likely to gain notice as a high mountain. This Kinabalu is no doubt the mountain said to have been in the fortunate island to which the Chinese Emperors Che Hwang-*Ze* (which I take to mean the Junior Lord of All Things) and afterwards Woo, who flourished about one hundred years before our era, sent expeditions in search of the Water of Life (see "Taonism," p. 238). And Kinabalu means simply the Chinese Widow.

Now I made enquiries of people, Muruts and Dusuns, who had domesticated the maias, and they said they had educated them so far as that they followed their masters to their daily labour at their farms, but never could be got to work. The most that was ever got from them in return for their food was that one, more intelligent than the many, had been taught to bring fire for his master's cigarette when requested to do so.

I should like to be able to inform you as to the period of gestation of the maias, and other points of its economy, but am not able to do this.

Note here:—I read a remark in your Journal that, notwithstanding (!) the fact that maias are not Carnivora, they have well-developed eye-teeth. The writer did not consider how useful these teeth are to the animal in tearing off the thick and rigid rinds of most of the forest fruit.

Note again:—One of your correspondents observes, as it appears in an extract quoted, that to the Dyaks of Borneo the maias is simply the orang utan, or "man of the woods." As a matter of fact, however, the Dyaks call the maias nothing else but "maias." In the north the Muruts call him "Kagui," and the Dusuns "Kaigiu." The only people in Borneo whom I know to call him "orang utan" are a single family of Arabs in the north, and very likely they got the name from the English settlers at Balambangan, at the close of the last century.

ANALYSES OF BOOKS.

Physiological Cruelty or Fact v. *Fancy: An Enquiry into the Vivisection Question.* By PHILANTHROPOS. London: Tinsley Brothers.

FIRST NOTICE.

BESTIARIANISM, like certain other parasites, is exceedingly tenacious of life, and is in no haste to quit its congenial home in certain human heads. Hence the work before us can in no wise be regarded as superfluous. On the contrary, from the moderation of its views and of its language, from the more than candour which it displays to opponents, and from the novel starting-point which it takes, it will be of great service in quarters where a sterner and more uncompromising advocacy of the rights of science might not find listeners. Our own opinion has repeatedly been expressed in the "Journal of Science:" it is that the "Vivisection Question" is utterly illegitimate unless raised by such persons only as refrain from inflicting pain and death upon animals for any purpose whatever. Such persons might, from their own point of view, consistently denounce physiological experimentation. But nature would effectually dispose at once of their arguments by "improving them off the face of the earth."

Our author, it will be found, calmly and quietly, but not the less cogently, exposes much of those exaggerations and misrepresentations which form the very staple of the so-called "anti-vivisection" movement. By means of such misstatements widely and industriously circulated, a strong prejudice against physiological research has been created, and many well-meaning men, and still more women, have been led astray. To remove the impression thus produced must be a work of time. Agitators of all grades well know that a falsehood may be conveyed in a few words, whilst its exposal demands considerable space. To this circumstance they owe their very existence.

"Philanthropos" at the very outset raises the question, "what is pain?" As a matter of fact we know nothing about any pain except what we have ourselves suffered. We infer that other men feel approximately as do we. But even here there is great uncertainty. It may be considered decided that most savage races, *e.g.*, the Red Indians of the western hemisphere, feel very much less than do we. When we come to the lower animals, our knowledge is very much more vague. We have so-called "signs of pain," that is, the starts, jerks, and struggles which wounded animals exhibit. But before jumping to the conclusion that these movements are a proof of pain and of consciousness, we must consider that such "signs of pain" can be produced not only after accidents, which place a limb out of connection with the nervous centres, but even after death. What, then, can they prove? Our author cites the following portion of the evidence of Dr. Anthony before the Royal Commission on vivisection (Question 2,484):—"A horse can kick after he is dead. A knacker, after he has cut off a horse's head, will pass a long rod down the spinal marrow to destroy its activity; otherwise, as soon as he began to skin the body the legs would kick with sufficient force to break his arm." The author adds, "Such a motion in response to a stimulation is called in scientific language a reaction; in agitationist language, 'a spasm of agony.'" This phrase seems to have been invented by Miss F. P. Cobbe, who in the "Fortnightly Review" for January, 1882, wrote: "The very fact that physiologists select petted dogs to exhibit reactions (*anglice* spasms of agony) under their operations, &c." Without seeking why two Greek works should be given as the *English* version of so simple a term as "reaction," we would ask whether Miss Cobbe is really ignorant that such movements are no proof of pain? If so she is no very safe authority.

Philanthropos aptly shows that Bestiarians themselves, in their accentuated protests against the liability of cats and dogs to physiological experiment, admit that different animals do not feel pain equally, the more highly organised being more sensitive than the lower. How, then, can they maintain that brutes feel just as we do?

He shows also that in the physical sufferings of human beings —adults at least—there is a mental factor almost entirely wanting in animals. This something is ably described in a passage borrowed from Mr. E. Gurney and taken from the "Fortnightly Review" of December, 1881.

We read that "dogs kept at physiological laboratories for the purpose of experiments display no such horror of the operating-room as was described in a sensational paragraph which was sent the round of the papers some time ago. A dog released from experiment has been known to jump up upon the operating table and sit there to inspect a companion having his turn, showing that no very painful impression could have been left upon his mind by whatever he had undergone. Dogs with gastric fistulæ enjoy life in perfect health, and will sit up or lie down when told to have different substances injected or extracted. At Professor Ludwig's laboratory, in Leipzig, the dogs used as subjects for many such experiments are neither tied nor chloroformed, but merely patted and talked to while the process is going on."

"Among human creatures we see the effect of mental development upon the sense of pain very clearly in the case of children. An infant can be vaccinated without making it cry if its mind is kept occupied by a bit of sugar held before it; and it will undergo even much more pain without discomposure if well amused. But when that child is three or four years older, he will understand that something is going to be done to him; he will be terrified at the preparations; neither sugar nor anything else will divert his mind, and he will be conscious of all the pain given, and probably exaggerate it from terror. If pain can thus be a secondary thought in the minds of infants it will be still more so in those of animals.

"A house-dog met with an accident by which a large piece of the skin and flesh above the eyebrow was cut and hung loose over the eye. His master, a surgeon (who furnishes the anecdote), determined to stitch it. Now, it is well known that—the skin being extremely sensitive—stitching is one of the most painful parts even of serious operations. The dog was taken into a shed, muzzled, and the cut stitched up. All the time that it was being done he was straining and struggling to get away, though never whining nor crying. The instant he was released he dashed into a corner of the shed and seized a bone which he had had his eye upon, and which had possessed his soul while he had been undergoing operation without anæsthetics.

"A horse, whose leg was badly broken, was sentenced to be shot; but there was considerable delay before the execution could take place. The bones were completely broken through, so that the leg hung loose, a state of things during which the least motion causes a human patient most exquisite agony. No suffering is worse than that from a broken bone, and the only way to prevent its becoming intolerable is to avoid the slighest jar which can grate the fragments against each other or the surrounding flesh. But during the two hours between its injury and its death this horse grazed and limped about to graze, carrying the broken limb dangling."

These two anecdotes, we learn, are vouched for by eye-witnesses, and we earnestly commend them to the consideration of all such "anti-vivisectionists" as are capable of dispassionate reasoning. The whole of this second chapter of the work before us will well repay attentive study.

The third chapter deals with the more difficult question, "What is cuelty?" The author's reply is, "the wanton or excessive infliction of pain." To this definition it may be objected that according to the foregoing chapter an estimation of the degrees of pain is exceedingly difficult. We should be inclined to call the infliction of pain and death cruel:

a. When objectless, or when the object to be obtained is frivolous.

b. When the inflictor feels a gratification in the infliction.

c. When the object can be obtained in some other manner without such infliction.

Our views differ here from those of Philanthropos mainly in that his defence seems merely to include experiments undertaken from a medical point of view. There are, as we have shown on former occasions, many physiological investigations urgently needed, but which conceivably may never have any direct bearing upon the methods of the physician, the surgeon, or the veterinarian. In summing up this section the author writes :—"I cannot expect that the facts and arguments of the foregoing chapters will convince every one. When all has been explained and argued there will still remain irreconcileables determined to persist in their war against scientific experiments. But we can now see clearly what this war amounts to. It is an effort to keep many animals in suffering instead of few, men instead of beasts, the more sensitive creature instead of the less sensitive." To which we add that it is an effort, and in many cases a wilful, deliberate attempt to keep mankind in ignorance.

We now come to a discussion of that phase of the subject which has elicited from Bestiarians the greatest amount of perversity and wrong-headedness, to wit, the consideration of "Our Rights over Animals." It is somewhat strange that this question should first be prominently raised in an age which has recognised the struggle for existence more distinctly than has ever been done before, and has found what this struggle involves. Nature seems to have invested every organism with the right to destroy, devour, utilise at pleasure any other organism so far as it is able. We can only exist by exercising this right. If we become too weak, or too fantastically scrupulous, we sign our own racial death-warrant. The author writes :—"The opponents of such experiments assert that they are wrong in themselves, and that, therefore, it is time wasted to prove that advantages are gained by them, since no profit can justify a crime. I most unreservedly admit that no hygienic gain is worth a moral loss, and that the health of one man's body is too dearly purchased by the disease of another man's soul."

It seems to us that this admission is of the widest. It may strike the careful inquirer that a moral code which involves hygienic loss to the community is not improbably tainted with error. Perhaps, too, it might be added that grandmotherly legislation should allow the experimentalist to judge for himself as to the effects of his researches upon his soul.

The reasons given by Bestiarians why physiological experiments are wrong in themselves are summed up by the author under four heads :—First, that they are cruel; second, that the infliction of pain hardens and demoralises the inflictor; third, that it is unjust to make animals suffer for our good; fourth, that it is an infringement of their rights which we have no authority to make."

The first of these contentions the author dismisses, like ourselves, as a *petitio principii*. Such experiments are not cruel from any rational definition of cruelty.

The second consideration holds good only when the production of pain is the purpose of the inflictor, and when he finds pleasure therein. As applied to physiological investigations, it is simply an untruth, as we are able to assert from long and extensive observation. Work upon animals, conducted in a true scientific spirit, is no more hardening and demoralising than is experimentation upon plants or minerals.

As to the third position of the enemy, Philanthropos profoundly remarks that it merges into the wider question of vicarious suffering. "Is it right that one creature should suffer for the good of another?" That such should be the case seems to be "one of the most comprehensive laws of the sentient world." In all our ordinary dealings with animals we "constitute ourselves administrators of this law, and apply it to them for our own interests." As we showed ("Journal of Science," 1876, p. 318) and as Philanthropos here contends, we torment and immolate animals without scruple for our convenience, our luxuries, and our pleasures. It is only when pain is inflicted in the pursuit of knowledge that the Bestiarian conscience is exercised. The fourth contention—that "physiological experimentation is a violation of the rights of animals which we have no authority to commit," seems due to one of the bitterest of the "Anti-vivisectionist" fraternity—the editor of the "Spectator." This argument, which after all is a mere exaggerated form of the foregoing, is not merely demolished but annihilated by the principle of consistency. If the "golden rule"—which fails completely if we seek to apply it to criminals—forbids us to experiment upon animals, no less does it forbid us to hunt them, shoot them, eat them, castrate them, or make them work for our benefit or pleasure! We are told to "put ourselves in the place of the lower animals, and ask what we, with their pains and their sensitiveness, and their prospects of life and pain and happiness, might fairly expect of beings of much greater power but of common susceptibilities." Suppose any advocate of the "rights of animals" were troubled with Entozoa, would he reflect on such "rights" before taking anthelmintic medicines? If, then, he is willing to slaughter animals—possibly with pain to themselves—for the preservation of his own health, should he seek to restrain investigations which are calculated to preserve the health of his fellow men?

(To be continued in our next.)

Light Science for Leisure Hours. Third Series. Familiar Essays on Scientific Subjects, Natural Phenomena, &c. By R. A. Proctor, B.A. Camb., Honorary Secretary of the Royal Astronomical Society, &c. London: Longmans and Co.

We have here a collection of essays and reviews, reprinted from various journals. Their subjects are, as might be expected, for the most part astronomical, and among these six of the most important are devoted to solar eclipses and their lessons. "The Earth in Meteoric Shadow" we have already noticed on occasion of its first appearance in "Longman's Magazine." The paper on "Lottery Schemes" is selected as here admissible on account of the mathematical considerations involved.

"Conduct and Duty" is a brief critique on Mr. Leslie Stephen's "Science of Ethics." Mr. Proctor contrasts the point of view taken by Mr. Herbert Spencer with that adopted by Mr. Leslie Stephen, and expounds the criterion of the latter ethicist.

"Under the title 'Vivisection," we find a short and favourable notice of Professor Owen's "Experimental Physiology." Mr. Proctor, though he occasionally writes for the "Spectator" and the "Echo," does not prophesy smooth things to the Bestiarians, and will accordingly be from time to time treated to missiles similar to those with which we are saluted:—

> "Jam fæces saxaque volant."

"The American Tariff" is a subject upon which we cannot legitimately enter. At the same time, we cannot but think it hard that the American savant and student should be called upon to pay import duties upon foreign scientific books, upon geological, or biological specimens and apparatus, and upon apparatus.

The "Origin of our Race" has a somewhat equivocal title. We expected to find a disquisition on the origin of mankind; but the "race" in question is, it appears, that sub-section of humanity which now occupies Britain. Concerning this race the author takes the very rational view that complexion, type of features, and shape of head form a more trustworthy evidence than language, and that the views of certain historians, based upon traditions and upon linguistic points, must be rejected. That our language is essentially Teutonic no one will care to dispute; but that in blood we belong very largely to a dark race seems even yet more plain. The only escape from this conclusion is the theory that as any nation advances in culture its complexion takes a more southern type. Some contend that this process is no less marked in France than in Britain. It must be remembered that, according to Roman authorities, the Gauls were no more a dark-haired people than were the ancient Germans.

"A Late Boat Race" does not fall within our cognisance.

"Are we Jews?" is, again, a paper with an equivocal title. Seeing its title in the contents, we expected a discussion on our alleged "Israelitish Origin." We find, on the contrary, an essay on Sabbatarianism, with reference to the refusal of the inhabitants of St. Kilda to land provisions sent for their relief on a Saturday lest the work might not be completed by midnight. The author further denounces the discontinuance of the weather warnings sent to the Continent from our Meteorological Office, as far as the Sunday is concerned. In so doing he has abundant justification. But we cannot go with him in the following contention:—"Sabbatarians lay great stress on the assumed fact that the rest is found good for body and brain—a fact which, if proved, would mean little more than that long-continued habit has made such rest a necessity. But they pay little attention to the fact that nature knows no seventh day's rest. The earth does not pause in her orbital motion round the sun, nor the moon on her motion round the earth. The tides and currents of the ocean continue their motion, and the waves rest no more on the Sabbath than on week-days. Winds blow and rains fall on that day as on the rest. All forms of life, vegetal and animal, continue unaffected, save only as they are related to man in those countries where the seventh day's rest is observed!"

To this strange argument we may reply that the comparison here drawn from the inanimate world is utterly beside the question, and if it could prove anything at all, it would show that our nightly rest had been made a necessity merely by long-continued habit. Plants have, under various forms, intermissions of rest and activity. Wild animals are nowhere goaded into unceasing toil from the beginning to the end of the year. Hence, for them, a seventh day's rest is not required. As to man, he has never, in the savage or in the barbarous state, or in the ancient civilisations, been driven to work as at present. Of this overwork, the consequences are only too patent. So far, then, from fancying that a day of rest is a mere matter of habit which might be dispensed with, we hold that our leisure wants increasing. If the easy-going shepherds and herdsmen of Syria needed one day's rest in seven, we require more. What name we give our rest, whether it should come in the form of entire days, or of portions of days, or whether an entire community should desist from its toil at once, are secondary questions with which we cannot meddle. We presume Mr. Proctor wrote this essay before the appearance of Mr. Herbert Spencer's memorable farewell address to the American people.

"Paradoxes and Paradoxists," though written eleven years ago by occasion of De Morgan's "Budget of Paradoxes," is still worth careful reading. The criterion given for distinguishing the mere paradoxist from the great discoverer will, we believe, in most cases, be found to work satisfactorily. "It is a thing which has never happened for a man without wide and thorough knowledge of a branch of science to make great discoveries in that particular branch." Of course an ignorant man may by hap observe some important fact hitherto unrecognised, but the probability is that if such a fact come before him he will see neither its importance, its meaning, nor its novelty. The vulgar contention "that it is unlikely for some unknown person to succeed where Newton, &c., have failed," is dismissed with the contempt it merits. Perhaps the most offensive instance of this fallacy in existence is to be found in a pamphlet by the Rev. F. O. Morris, B.A., entitled "All the Articles of the Darwin Faith" (see "Journal of Science," 1878, p. 467).

The advocates of the so-called "Zetetic Astronomy," are naturally weighed in the balance, and found wanting. Among them figures, of course, "Parallax," known in 1849 as S. Goulden, and afterwards as Rowbotham. Mr. Proctor happily remarks that the name parallax "may have been chosen to indicate his wish to change the accepted views of the universe, for does not Liddell and Scott's 'Lexicon' give as the meaning of the verb *Parallasso*, '*to change or alter a little*, especially *for the worse*,' or else, as indicative of the ingenuity of the man in avoiding any argument which appeared irresistible (for the verb means also to *slip aside*, *escape*, or *dodge*). His skill in this respect was remarkable. He would reason at any length with those who had a smattering of astronomical knowledge, and he would only occasionally, by some reference to scripture, exchange what resembled argument for an 'appeal to the gallery'; but when a really unanswerable argument was brought against him, he had a simple but effective formula, which always afforded a loophole for escape: 'Come, sir,' he would reply, 'you have said your say; others wish to speak as well as you.'" So much for public discussions!

A smile will, perhaps, be called up to the face, and an old adage to the memory of the reader when he encounters the following passage:—"No one is likely to believe that there is a semi-transparent moon merely because 'Parallax' says there is; while probably nine-tenths of those who have read Lockyer's 'Elementary Lessons in Astronomy' are satisfied that seamen find local time 'by observing when the sun is at the highest point of its path' (article 564); that when the sun moves fastest the dial will get before the clock, and *vice versâ* (article 416); and so on with the other blunders in that too clever compilation. But, though the mischief done by the paradoxist with his false science is less serious than that accomplished by those who write about real science without sufficient knowledge, yet the study of paradoxes is not on that account to be recommended."

An essay on the "Influence of Marriage on Death and Crime," opens with the remark:—"There are reasons for believing that a good hearty blunder has a better chance of thriving than an average truth." The author writes:—"I take it that of all possible resources for those of tainted or feeble constitution, of strongly criminal tastes, or of insane tendencies, matrimony is, on the whole, the most objectionable, as far as the community at large is concerned. If a consumptive person could add ten years to his life by marrying, he might also add ten consumptive persons to the next generation; and who shall say how widely the taint would spread in later years? The criminal is hardly likely to be influenced by other than selfish considerations; but most certainly the community has no reason to desire that he should be encouraged to increase and multiply criminality. As for a person who inherits a tendency to insanity and knows it, such a one, if he entertains whilst still sane the thought of marrying, is a criminal of deepest dye, and the worst thing that can happen to the community is that his insanity should delay to manifest itself until the taint has spread to his innocent offspring.

"Light Science" will supply many persons with matter for useful reflection.

Longman's Magazine. No. VI. April, 1883.

In this issue we have to notice a paper by Mr. J. K. Laughton, entitled "Wind-force, and how it is Measured." The author chronicles the effects of some of the greatest storms on record, those especially of November 26th, 1703, and of October 14th, 1881. He suggests the damage done to trees as furnishing a standard for roughly comparing the force of these visitations. It is, however, not overlooked that the storm of 1881, though far more destructive than that of 1703, came at a season when the trees were still in leaf, and when the ground was softened with rain. Furthermore, the wind came from the N.N.E.—an unusual direction for an autumnal storm.

There is another consideration of some moment. The entire area of woodland now standing in England is very much smaller than was the case in 1703, so that the destruction of (say) 40,000 trees in our day shows a relatively greater devastation than the overthrow of a similar number a couple of centuries ago. The exorbitant degree to which the surface of England has been denuded of trees gives also fuller play to storms than was formerly the case. Hence we find it here remarked that though the damage on land was greater in 1881 than in 1703, the havoc at sea was smaller.

Mr. Laughton explains the difficulty of measuring with any approach to accuracy the velocity of, or the pressure exerted by, the wind in storms. Taking the best instrument for the purpose, which is probably Robinson's anemometer, now employed in this country, over the greater part of Europe, and in America, the question arises—Where is it to be fixed up? We want a situation where the wind is neither intercepted nor diverted from its even course. Everyone must have observed that when wind blows against a wall it rebounds in all directions, and rushes with a concentrated force round the end or over the top of the obstruction. It is observed by gardeners that these deflected currents are far more ruinous to vegetation than the direct sweep of the wind in the open. It is at the corners of streets that umbrellas are turned inside out and that hats are whirled off into the realms of space. Hence the only spot at all suitable for erecting a wind-gauge is at the top of a pole, 20, 30, or perhaps 40 feet high, set in the midst of an open field. We may add the further condition that this field should be in a level country. If on the slope of a hill, or amongst hills, the force of the wind may be either partially broken or intensified, according to its direction.

There is a further consideration: we have no reason to suppose that the velocity of the wind in a tempest is uniform from minute to minute or from half-hour to half-hour. Even where there is no scope for interception, deflection, or rebounding, as on the open sea, we observe gusts of intensified violence intervening between lulls. Hence the average hourly velocity of the wind, however fairly measured, does not tell us what has been its maximum velocity. Now this maximum velocity is precisely what the engineer needs to know in order to adapt his structures to the greatest pressure which they may probably have to encounter. This maximum velocity we are hitherto unable to find with anything like precision, and the highest authorites are here not at one. Our ignorance on this point was brought into full relief on occasion of the Tay Bridge disaster. As Mr. Laughton puts it, "Engineers of the highest repute had no exact knowledge as to whether the extreme probable force of wind should be taken as ten pounds on a square foot, or twenty, or forty."

In the tempest of October 14th, 1881, a pressure of 53 lbs. per square foot was indicated at Greenwich; and at Liverpool, in March, 1871, a pressure of 90 lbs. is said to have been registered. This result has been strongly questioned as far as England is concerned. But the speed of an American tornado is estimated as having a mean velocity of 392 miles per hour, and a maximum of 800 miles, which answers to a pressure of three-quarters of a ton per square foot. Such figures, to those who judge merely from the ordinary power of the wind, seem absurd. But if we examine the recorded effects of such tempests we find that the question takes a different aspect. In the tornadoes of the Western States heavy pieces of machinery have been carried away to considerable distances. In a West Indian hurricane heavy artillery has been dismounted and hurled away.

In speaking of the devastation of the town of Walmer by the whirlwind of October 24th, 1878, Mr. Laughton agrees with Mr. Symons in the opinion that much of the damage in such cases may be due to a sudden rarefaction of the air. A rarefaction to the extent of 0·2 inch of the barometer would give the air in buildings over which it passes a lifting power of about 14 lbs. per square foot. Hence in the Walmer storm we have record of "the vertical lifting of slated roofs, and the simultaneous *outward* explosion of the walls, even *towards* the wind." A whirlwind that passed near Vendôme, October 3rd, 1871, took off the roof of a barn, and lifted bodily out of it a cart which had been left inside. "The walls of the barn were not injured, but the cart was found 150 yards away."

We must here remember that the difference between a tempest —or even an ordinary wind—and an explosion is merely one of degree. Wind is gaseous or aëriform matter in motion. So is explosion, the motion being in this case the sudden conversion of matter from the solid or liquid to the aëriform state, which of course implies vast expansion. Explosion shatters bodies in pieces, because the velocity of the gaseous matter is so great that solids exposed to it have, in familiar language, no time to yield to the pressure.

The Mason College Magazine. Vol. I., No. 4, April, 1883. Birmingham: Cornish Bros.

THIS little periodical contains more thought, and more matter provocative of thought, than some of its bulkier and more widely-circulated contemporaries.

First in place, as perhaps in importance, is a paper by Miss Constance C. W. Naden, discussing the question "Is the increasing predominance of Brain over Muscle conducive to National Welfare?" The problem to be solved is one of extreme difficulty. As far as our observation goes bodily vigour and endurance form a necessary substratum for continued cerebral activity. It must be conceded that brain-work under the pressure of anxiety is fearfully enfeebling; but we cannot see that the scientific specialist of the present day is necessarily working under more unhealthy conditions than the polyhistor of the past. The very contrary is the case; the geologist or the biologist, if of the modern school, is bound to spend much of his time in the open air, instead of sitting at a library table poring over what other people have thought and said before him. Consequently he retains his physical vigour in much higher degree than many people who are not fairly classed among brain-workers. Again, even the most exclusive specialist, be he entomologist, fungologist, muscologist, or the like, has, as a rule, a passionate love for the beautiful in Nature far more intense than is found in average mortals. So that whilst his intellectual life is quickened, his æsthetic being also is maintained in activity.

But we can fully admit that we as a nation, though we do less brain-work than one at least of our neighbours, expend more brain-power, in consequence of our unhappy system of competitive examinationism. Here lies the national danger. The champions of this system should be called upon to show why it will not, in our case, result in the same mental stagnation which has resulted from it in China. We can never bear too clearly in mind that all the world's best brain-work is non-competitive.

Mr. Greatheed, in his reply to Miss Naden, brings forward some points which ought not to be overlooked.

"An Unreported Debate" is a strange production. We have the "Apostle of Sociology" moving a resolution "that man is a degenerated frog," whilst the negative and affirmative sides of the question are upheld by the "Man of Character," Hypatia, Demosthenes, "1001 Gems," "The Bookworm," the "Queen of Hearts," and others, the motion being ultimately carried by a large majority.

An interesting debate on the difference between Reason and Instinct is somewhat briefly reported, and by a misprint we read "that the difference between Reason and Intellect is one of degree."

We are happy to find that the Physiological Department of the Mason College is in an active condition, and that the instruction given is of a thoroughly practical character.

The Popular Science Monthly. Vol. XXII., No. VI. April, 1883.

In the issue before us of this valuable organ of scientific opinion there are certain papers which justify an especial notice.

Mr. McElroy's remarkable memoir on the "Economic Function of Vice" is, in one of its phases, discussed in an article in our current number. We cannot help, however, noticing with regret that the writer seems to recognise but one motive for effort, that is to say the "passion for worldly advancement." He writes: "The humblest work incessantly to lift themselves into the ranks of the middle classes. The middle classes strive as earnestly to make themselves plutocrats, aristocrats, and lordlings. When a man at last reaches the social summit he desists from further efforts at improvement, or if this period (? point) comes too late in his life his children do it after him. Some vice speedily removes him, and clears the ground for another man to come to the front, who is also removed summarily when he becomes obstructive." This, if true, would be a very sad picture of the world. The best and noblest work has little, if any, direct influence on the social position of those who execute it. There are, we are thankful to say, men not a few who, if only in such a position that their time is at their own disposal, entertain worthier aims than becoming "plutocrats or aristocrats." Such has been the career of the Darwin family since the time of the Great Rebellion. We devoutly hope, if the world grows wiser, that wealth and title will be less exclusively worshipped, and, in consequence, less generally sought for than they are at present.

Dr. F. L. Oswald completes his suggestive dissertation on the "Curiosities of Superstition." He makes the significant and perfectly true remark that "mental aberrations can become epidemic." The writer sarcastically declares that: "The precipitate follower of Bacon has noticed the coincidence of cold weather and catarrhs, and jumps to the conclusion that a low temperature deranges the functions of the respiratory organs." Might we remind him that in the severest Siberian cold respiration is so much interfered with that every breath is painful? On the subject of alleged forebodings we find a startling utterance. "Apollonius of Tyana foresaw even the great *aphanasia*, the fifteen hundred years' eclipse of common sense and reason. 'Woe be to our children!' he exclaimed on awakening from a trance; 'I see a shadow approaching; a great darkness is going to cover this world.'" If these words were really uttered they seem a strange prediction of the decay of the ancient classical civilisation, of the relapse into barbarism, and of the dirt, the asceticism, and the unreason of the Dark Ages.

Dr. W. A. Hammond communicates a paper on "Perceptional Insanities"—hallucinations far more common than is generally supposed.

Certain "Speculations on the Nature of Matter," by Mr. H. H. Bates, will be reserved for future consideration.

Under the heading "Editor's Table" some noteworthy remarks are made on the new weekly American journal which has recently appeared. Whether it is to be regarded as a resuscitation of a former journal bearing the same name, which we used to read with both pleasure and profit, we do not find stated. We note the plan of our new contemporary and the important functions which it is to perform, which, however, will *not* include advocating the interests of a "Science and Art Department." Its enunciations on "The Future of American Science" seem to us, however, as well as to the Editor of the "Popular Science Monthly," open to criticism. That future is proclaimed to be distinctly and super-eminently utilitarian. We shall regret should such be the case. Strictly speaking there is no " utilitarian " or " applied " Science. What commonly bears the name is industrial art. The writer admits that "the man who discovers nothing for himself, but only applies to useful purposes the principles which others have discovered, stands upon a lower plane than the investigator." Yet he continues:—" But when the investigator becomes himself the utiliser, when the same mind that made the discovery contrives also the machine by which it is applied to useful purposes, the combined achievement must be ranked as superior to either of its separate results." No, we reply, a thousand times no. The highest discoveries are incapable of direct utilisation. What " machine " can apply to useful purposes the life-work of Darwin, the periodic system of Mendelejeff, the atomic theory, the doctrine of gravitation, the discovery of the circulation of the blood, the researches of Joule, of Lyell, and, in fact, all the great " epoch-maching " triumphs of research ? It is only the smaller discoveries, the bye-issues, which fall, as it were, crumb-like from the table of Science, that can take the form of direct inventions.

We must further consider that if the investigator forsakes his own task to devote himself to inventions and patents, he sins against the great principle of the division of labour.

The writer in " Science " touches closely upon the ridiculous when he writes : " While the scientific cynic may condemn the utilitarianism of our age, the more liberal man rejoices in it." Surely we have here a gross perversion of language. The man who rejects selfish considerations cannot rationally rank as a " cynic," whilst he whose motive is greed can scarcely claim to be called, in any honourable sense of the term, " liberal." We hope that this ill-advised essay does not strike the key-note of " Science."

Sound. By JOHN TYNDALL, D.C.L., LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution of Great Britain. Fourth Edition. London : Longmans and Co.

THIS work, which has already reached its fourth edition, is characterised by its clearness—we might say elegance—of exposition, and by the total absence of mathematical formulæ. To take an illustration, the reader finds here the completed building, free from the ladders and scaffolding used in its construction. Hence it is intelligible not merely to the physical specialist, but to a much wider circle. This is doubtless the author's purpose in entitling his book "Sound," instead of "A Treatise on Acoustics." It would be a great mistake, however, to suppose that we have here a popular treatise in the common and objectionable sense of the term. We do not find here inaccuracy, looseness, or the curtailing and perhaps omission of important truths. The production and propagation of sound, and all its essential phenomena, are explained in a manner intelligible to common sense.

Among the facts not generally known, which may here be met with, is Hooke's anticipation of the stethoscope, which the author well puts forward as an instance of the action of scientific imagination.

In drawing a distinction between noise and sound, Professor Tyndall advances an opinion which is not altogether admissible.

He writes :—"The action of noise upon the ear has been well compared to that of a flickering light upon the eye, both being painful through the sudden and abrupt changes which they impose upon their respective nerves." That noise is often painful needs no demonstration, but it is painful not as such, but in virtue of loudness and accentuation. Few noises are more distressing than, *e.g.*, the tolling of a bell. Here the sound, however musical, is loud, sharply marked, and is repeated at regular intervals.

Several important books which have been received for review must stand over from want of space.

CORRESPONDENCE.

⁂ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

DO SNAKES SHELTER THEIR YOUNG IN THEIR THROATS?

To the Editor of the Journal of Science.

Sir,—May I intrude on your space to reply briefly to the letter of Mr. James Simson, of New York, in the May number of your Journal, with reference to the question "Do some snakes offer a refuge to their young, in their own throats?"

First, I would thank Mr. Simson for sending me his interesting work, duly forwarded by Messrs. Griffith and Farran. I must also, under present circumstances, express regret at my omission of Mr. Simson's painstaking investigations on this interesting question in my work on "Snakes." Truth to tell I did see the English edition of Simson's "Contributions to Natural History" soon after its publication in 1875, and even quoted it in the first sketch of my 27th chapter; but I found that references to it must partake too much of the nature of a controversy (Mr. Simson will pardon me for not coinciding entirely with his ideas), and that important quotations from the "Reports of the American Convention on Snakes," held in 1872, as well as those from our English zoological journals, already occupied more than the space allotted to other chapters. My task was indeed no easy one, some deference being due to certain able zoologists in England who doubt the existence of any maternal affection in reptiles. By this time Mr. Simson has, I trust, been able to look at my work, which can be obtained from Messrs. Dutton and Co., of New York, and he will therein discover that "a careful examination of the anatomy of the snake, to ascertain the physical peculiarities connected with the phenomenon described," has been made again and again; and that there was no indication of the "two throats in the female snake," as suggested by Mr. Simson, but that there seemed every possibility of ample refuge in the expansile œsophagus. The young are supposed to go no further.

Mr. F. W. Putnam, before writing his valuable paper in the "American Naturalist" (1869, quoted by Prof. Browne Goode at the American Convention), had made himself acquainted with these anatomical investigations, conducted by Dr. Edwardes Crispe, of London, so long ago as 1855, and published in the Zoological Society's Transactions subsequently, together with further corroborative testimony. All this was fully discussed at the Convention, the "Reports" of which do not appear to have fallen under Mr. Simson's notice, but which would put him in possession of all the evidence collected up to that date.

"I lay it down as an axiom that we must hold that *all* snakes swallow their young, till the opposite can be proved of any particular species of them," says Mr. Simson, page 29 of his "Contributions"; and again, on page 198 of his Appendix (American edition):—"To prove the contrary" would be difficult,—nay impossible, unless every female snake on earth were watched from birth to death! Besides, are we warranted so to establish a fact in Natural History? Mr. Simson will see that I have ventured to put forth some speculations of my own, restricted to certain species, and founded on personal observations (page 500 of my work).

With regard to snakes in captivity, we certainly have some evidence of maternal instincts in a display of unusual irritability and spitefulness during the period of incubation. And it is now a recognised fact that several species of snakes, formerly supposed to be entirely indifferent concerning their eggs, keep, on the contrary, a careful watch over them, or even incubate them in a nest of their own contrivance. The still greater phenomenon of the retarded deposition of eggs, or of an oviparous snake becoming a viviparous one, would seem to be due to maternal solicitude, and to have some bearing on the question of the maternal refuge (p. 499 *et seq.* of "Snakes").

With all respect for Mr. Simson's zeal, we must still regard the question as a "vexed"—because, in the eyes of the authorities in England, an unproved—one. Our one native viper is now becoming scarce, and unprejudiced observations are rare. Prof. Browne Goode succeeded in gathering together an immense mass of evidence during the summer of 1872. Let the same class of observers in America contrive to secure without violence any female snake seen thus to refuge her young, and send her, *with her progeny in her throat*, to some of the scientific authorities. It would not be difficult to catch her; for those who would not venture to grasp a rattlesnake might, without hesitation, seize the head of one of the harmless kinds which are said to display this protective instinct, and twist a string so tightly round her neck that the young could not possibly escape.

In the case of a venomous serpent, a cool and courageous farmer—and there are many such in America—might adroitly throw a cloth or a handkerchief over its head, which held down with the foot or a stick would prevent the escape of the young; a cord may then be tied tightly and speedily round the throat, *over* the handkerchief, effectually capturing the entire family, which have been seen to enter the mouth. Then plunge the whole—handkerchief, cord, and all—into a jar or bottle of alcohol, and dispatch it to Prof. Baird, of the Smithsonian Institute, or to some other American herpetologist. Better still, pack the bottle in a box of sawdust, and address it to the Zoological Society of London, 11, Hanover Square. They would, no doubt, be willing to pay a good price for so valuable a specimen, which, from a *well-accredited witness*, would "set the matter for ever at rest" in the Old World as in the New.

Unfortunately the tendency to fill up spare corners of newspapers with "snake stories" in America, where humorous journalists vie with each other in outdoing the marvellous, throws discredit on the few incidents that may be true among them; for—to use the words of Prof. Owen, when regretting this misuse of journalism—"it is far harder to kill an *untruth* than to establish a *truth*."

With snakes in captivity we are unlikely ever to witness this display of maternal refuge, since the cause of provocation cannot exist. It would be impossible to so entirely seclude the snakes that they should be unfamiliar with human beings. They must be fed and otherwise cared for, and so become, to a certain extent, "tame" in their abnormal condition.

Let me conclude with a hope that the present summer will not pass without the capture of at least one of the many pattern-mother snakes annually recorded as living refuges.—I am, &c.,

CATHERINE C. HOPLEY.

PALÆOZOIC ROCKS IN AMERICA.

To the Editor of the Journal of Science.

SIR,—Referring to your remarks on Mr. Kinahan's memoir on Palæozoic Rocks in Galway and elsewhere in Ireland, supposed to be Laurentian (Vol. v., No. cxi.), I observe you refer to Dr. T. Sterry Hunt, who "twenty years ago admitted that certain Donegal rocks could not be distinguished from altered palæozoic strata in America."

Dr. Hunt has changed his opinion, and no longer—since 1870 I think—regards these strata as altered palæozoic, but as probably Huronian.

I have myself carefully examined them since then from Vermont to Gaspé, and am in a position to assert and to prove that the whole evidence is in favour of their pre-Cambrian age.

Physically and mineralogically they correspond with the Huronian *series* of Sir William Logan, which some authors have asserted, without any sufficient evidence, rest unconformably on the Laurentian: this assertion Sir William Logan himself never ventured to make, and the truth of it no member of this Survey has yet been able to confirm, though many miles of both Series have been examined from Nova Scotia (Cape Breton) to Lake Winnipeg. The result has been, in the East, to cause us to give up the attempt to define them as separate formations, and to classify them all simply as pre-Cambrian. A similar result has, I understand, attended a similar attempt on the Pennsylvania Geological Survey. I may add that I have no doubt whatever of the correctness of recent views respecting the schists, &c., of Anglesea and Caernarvon, which I mapped on the British Survey with Sir A. C. Ramsay some thirty-five years ago, namely, that they are likewise of pre-Cambrian age. They correspond exactly with the so-called altered Quebec group of Logan; but here the evidence of stratigraphical position is much more distinct,—indeed it is so plain along a line of more than 150 miles as to leave no reasonable doubt on the matter.

Some day we may discover a sound basis of separation for Laurentian and Huronian, but as yet this has not been done in Canada, unless mere mineralogical differences in groups of beds are to be taken as such,—a feature which appears to be also characteristic of the supposed Laurentian rocks of Ireland.

The subject is one I take great interest in, and, though I have written but little about it, I have perhaps studied it over a wider geographical range than any other living geologist.—I am, &c.,

Alfred R. L. Selwyn.

A BOLIVIAN SAURIAN.

To the Editor of the Journal of Science.

Sir,—The "Anglo-Brazilian Times," March 24th, 1883, says that "the Brazilian Minister at La Paz, Bolivia, has remitted to the Minister of Foreign Affairs in Rio photographs of drawings of an extraordinary Saurian killed on the Beni after receiving thirty-six balls. By order of the President of Bolivia the dried body, which had been preserved at Asuncion, was sent to La Paz. It is 12 metres long from snout to point of the tail, which latter is flattened. Besides the anterior head, it has, 4 metres behind, two small but completely formed heads (?) rising from the back. All three have much resemblance to the head of a dog. The legs are short, and end in formidable claws. The legs, belly, and lower part of the throat appear defended by a kind of scale armour, and all the back is protected by a still thicker and double cuirass, starting from behind the ears of the anterior head, and continuing to the tail. The neck is long, and the belly large and almost dragging on the ground. Professor Gilveti, who examined the beast, thinks it is not a monster, but a member of a rare or almost lost species, as the Indians in some parts of Bolivia use small earthen vases of identical shape, and probably copied from Nature."

If this account should prove to be accurate it would form a counterpart to the etching of the mammoth which forms so interesting a memorial of pre-historic art.—I am, &c.,

WILLIAM E. A. AXON.

Fern Bank, Higher Broughton, Manchester.

NOTES.

Bird-eating Frog.—The following curious narrative is taken from the "Cape Times," March 27th, 1883:—"A lady living in the George district supplies the 'G. R. Herald' with the following particulars of the remarkable habits of this creature:—'I have much pleasure in furnishing all the information we have regarding the large frogs which have proved so destructive to our young chickens. A water-sluit runs round our terrace, and passes through the ground over which the poultry range, and in this the frogs harbour. The first time our attention was drawn to their bird-eating propensity was by the cries of a small bird in a fuchsia near the stream. Thinking it had been seized by a snake, several hastened to the spot, and saw a beautiful red and green sugar-bird in the mouth of a large greenish frog: only the bird's head was visible; and its cries becoming fainter, the frog was killed and the bird released. Its feathers were all wet and slimy, and for some days after we could distinguish it in the garden by its ruffled plumage. Since then the same species of frog has on several occasions been killed with young chickens, half-swallowed, and once a duckling was rescued from the same fate. Whether the noise is natural to these frogs, or assumed to decoy the chickens within their reach, we know not; but they constantly make a chuckling sound so exactly like a hen calling her chickens for food that we have seen whole broods deceived, and rushing towards the sluit where they supposed the hen to be. The frogs are very wary, and it is difficult to find them unless by the screams of their victims. We have lost large numbers of small chickens in an unaccountable manner, and feel sure now that these frogs must be answerable for very many of them, as there are no rats here, and the chickens are carefully housed at night. If I can give you any further details I shall be glad to do so.'"

Quinine and cinchonine, if introduced hypodermically into Guinea-pigs, rabbits, and dogs, prove fatal if the dose is sufficient. A dog weighing 12 kilos. died from a dose of 2 grms.

One Joseph A. Steiss, D.D., in a treatise on "Primeval Astronomy," declares Evolution "a lie." This is a simple and "primeval," but unfortunately not conclusive, style of argument.

Prof. Palmieri announces the existence in the lava of Vesuvius of a substance giving the spectrum line of "Helium,"—an element hitherto recognised only in the sun.

Doubts are thrown ("American Journal of Science") by competent authorities as to the nature of the alleged "lignified serpent" of Matto Grosso. It is suggested that the specimen is merely the track of a wood-eating larva, which has been filled up by the growth of new wood.

M. C. Dareste ("Comptes Rendus") finds that eggs, if submitted to intense and numerous vibrations, almost invariably produce monstrosities. This teratogenic cause is the more remarkable as coming into play *before* the development of the embryo. Fecundated eggs which have been carried by railway prove frequently barren if placed under a hen immediately after a journey. If they are allowed to rest for about three days before incubation they give rise to chickens.

Mr. H. Spicer ("Light") gives an account of the spirit of a Pomeranian wolf-hound having appeared to its master at the moment of death.

Mr. W. F. Barrett, in the same journal, describes a clairvoyante as seeing with great difficulty when the wind is high and the air charged with electricity. When there is a snowstorm she cannot see at all.

M. Hervé Mangon, having observed that *Mesembryanthemum crystallinum* takes up from the soil an extraordinary quantity of alkaline salts, proposes to employ it for removing the excess of such salts from land on the sea-coast and in salty deserts, so as to make it gradually fit for ordinary vegetation.

According to "Forest and Stream" an albino raven is now living in the Berlin Aquarium.

M. J. Reiset ("Comptes Rendus") finds that the products of respiration in animals depend more on the nature of the diet than on the species. A part of the nitrogen set free in the transformation of the albumenoid matters is eliminated as gas. In herbivorous animals there is a considerable escape of a hydrocarbide.

M. A. Robin ("Revue Scientifique"), in an investigation of the anatomy of the Cheiroptera, shows that in different species the uterus varies from the simple form which it has in the higher Primates to a double organ with two separate openings into the vagina.

According to "Wiedemann's Beiblätter" a shark belonging to the genus *Scymnus* is phosphorescent over its whole under surface, with the exception of a black stripe on the neck. The upper surface is non-luminous.

It is being now generally admitted that the "origin of the fittest" is no less important than the "survival of the fittest."

According to Mr. D. Morris the mungus is the most efficient rat-catcher yet introduced into the West Indies. Unfortunately they do not confine their attention to rats.

According to Dr. Miklucho Maclay some of the native tribes of New Guinea do not even know how to kindle a fire.

Prof. A. E. Verril, in a paper reproduced by the "Scientific American," comments on the absence of vertebrate remains on the sea-bottom beneath the Gulf-stream.

We regret to learn, from the "Medical and Surgical Reporter" and the "New York Medical Journal" that an "Anti-Vivisection" Society is about to be formed in Philadelphia. Nobodies and charlatans will find this an excellent opportunity for gaining notoriety. Yet "Science," writing but a little earlier, says, "American Science has nothing to fear from the future."

Mr. F. W. True, of the U. S. National Museum ("Science"), calls attention to the swinging of the human arms when walking as an inheritance from a semi-quadrupedal state.

M. Ed. Perrier ("Comptes Rendus") concludes, from the results of deep-sea dredgings, that the abysmal fauna is in great part descended from that of the littoral regions, and has become acclimatised in the depths. The conditions of existence being there constant, this fauna exhibits little variation.

According to the "Indian Forester" Australian acacias, if transplanted to the north of India, after many years gradually modify their time of flowering to suit the change of climate, and blossom in June instead of October.

Mr. Jeffries describes, in "Science," a hermaphrodite bird, a green-tailed towhee (?), from Colorado. The sexual organs were male on the right side, and female on the left. The plumage was that of a female.

According to Mr. J. Jamieson (Royal Society of Victoria) a direct action of the sun's rays, as such, upon bacteria has not been definitely shown.

M. J. Reiset ("Comptes Rendus") shows that cow's milk, as it issues from the teat, is not alkaline, but rather inclining to acidity.

M. J. A. Fort ("Comptes Rendus") has made an experimental study of the physiological action of coffee. He finds that its immediate effect is to excite the central nervous system, and that it neither increases nor diminishes the proportion of azotised food which requires to be consumed.

According to the " Popular Science Monthly " a genuine aquarium devoted to biological research is about to be established by the United States Commission of Fish and Fisheries, at Wood's Hole, Massachusetts.

Herr Engelmann (" Botanische Zeitung ") has demonstrated experimentally that only the pigmentiferous cells in plants, and in these only the pigmentiferous particles of plasma, are capable of giving off oxygen under the influence of light. In the vegetable world there exist, besides chlorophyll, a series of other colouring matters (chromophylls) which exert an assimilatory action.

Dr. J. D. Caton (" American Naturalist ") gives instances of curious friendship between a sand-hill crane and a family of swine; also between a Hawaiian goose (*Bernicla sandwicensis*) and a litter of young pigs. A male Wapiti deer, in the Ottawa acclimatisation grounds, forsook his mate and attached himself to a Durham heifer, but his frequent intercourse with her did not lead to the production of hybrids.

E. Baumann (" Pflüger's Archiv. ") criticises very sharply the results of Loew and Bokorny on the chemical cause of life. He maintains that chemical distinctions between living and dead protoplasm have long been recognised, and that the reaction recognised by L. and B. is not of general importance.

M. Cornu (" Naturforscher ") proves that gases may be absorbed through the epidermis of the aërial organs of plants. The grapes in a vinery were spoiled because the gardener had coated some plant-stages with badly-smelling tar-oil. The offensive flavour was stronger in the centre of each grape than on the skin. The roots and stems of the vines were outside the house.

According to Col. Venukoff there exist great anomalies in the different magnetic elements in the neighbourhood of Belgord, in the province of Kursk. There is no trace of iron-ore in the district.

Prof. Bruns, of Tubingen, finds that a portion of marrow, freed from bone and inserted under the skin of the same animal at a point distant from its origin, gives rise to the formation of bone and cartilage at the point in question.

A new vegetable parasite, *Haplococcus reticulatus*, has been recently discovered in pork by Dr. Zopf. It occurs in from 30 to 40 per cent of the animals examined. Would it not be well if we paid more attention to the sanitary legislation of Moses, doubtless a fragment of the ancient medical lore of Egypt?

In Italy the water of hot springs is being extensively used in horticulture for the production of early crops. The same thing is being done on a large scale in Japan.

L. Palmieri ("Rend. Accad. di Napoli") observes that if several chlorides are introduced simultaneously into the same flame, the spectral lines of only one of them are often seen. Copper chloride, unless in large excess, is not visible in presence of sodium chloride.

There has lately sprung up an Association, or Union, or "Movement," for opposing the "Deceased Wife's Sister's Agitation." Characteristically, there is among the members of the committee not a single medical man or physiologist—the only class entitled to be heard on the question.

MM. W. Wroblewski and Olszewski have solidified carbon disulphide at −116° C., alcohol at −130·5° C., and have obtained oxygen as a colourless mobile liquid at 135·8° C., under a pressure of 22 atmospheres.

During anti-cyclones the temperature of mountain stations fluctuates strangely within a few hours. According to "Ciel et Terre" the following temperatures were registered at Trogen, at the altitude of 892 metres, on December 6th, 1869:—At noon, 10·2° C.; at 1 p.m., 9·4°; at 2, −4·6°; at 3, 4·3°; at 4, 4·1°; at 5, −4·8°; at 6, 8·8°; and at 7, −4·2°. Thus from 5 to 6 p.m. the thermometer rose 24·6° F., and fell nearly to the same extent by 7 p.m.

Dr. Joseph proposes to attack field-mice by means of a highly contagious and fatal skin-disease to which they are liable. This disease is occasioned by a parasitical fungus (*Achorion Schönleinii*). Dr. Joseph proposes to catch a few mice, treat them with the fungus, and turn them loose.

Dr. Stumpf ("Archiv. f. Klin. Medicin.") has made some interesting experiments on the influence of certain medicines upon the secretion of milk. Small doses of potassium iodide administered to a goat doubled the fatty matter and increased the sugar in her milk, the albumenoids and salts remaining unchanged. Lead slightly increased total solids and albumenoids, but diminished fatty matter. Morphine produced no perceptible change. Alcohol—whether pure, diluted with water, or in the form of beer—increased sugar and fatty matter, decreasing the specific gravity, and leaving the quantity unaffected.

Covering the skin with an air-proof varnish is, according to Dr. Ellenberger ("Deutsche Zeitschrift. Thier-Medizin") not necessarily fatal.

Prof. Kirchner, in a long series of researches, confirms the conclusion of Darwin that only the point of the root of plants is directly sensitive to gravitation.

According to H. J. Brautlecht ("Naturforscher") microbia may be found in abundance in the moisture condensing on the sides of a bell-glass placed over sand, gravel, or garden-mould which had been previously watered with a fluid containing bacteria.

Baron Ettingshausen finds that the Tertiary flora of Australia is far more nearly allied to the Tertiary floras of the other continents than to the living flora of Australia.

Mr. D. Mackintosh ("Geological Magazine") agrees with the late T. Belt in considering that only a few thousand years have elapsed since the glacial beds were laid down, thus rendering it less remarkable that no new species of animals seem to have appeared since the Glacial Age.

M. Richet has been elected to the vacancy in the French Academy of Science (Section of Medicine and Surgery) by 32 votes as against 23 polled by M. Brown-Sequard.

M. P. Mégnin ("Comptes Rendus,") gives an instance of the direct reproduction of a tape-worm (*Tænia serrata*), in the intestines of a young dog, without any possible larval migration.

Dr. C. A. Cameron, at a meeting of the Academy of Medicine in Ireland, read a paper showing that consanguineous mariages were a cause of deaf-mutism. Other medical gentlemen present gave instances of the racial injury occasioned by such marriages.

F. H. Storer ("Science") mentions that a hawk (*Buteo Pennsylvanicus*) was found, when shot, to have its stomach entirely full of caterpillars.

S. Kneeland writes to the same journal to say that the house-fly is extremely rare in the Philippines.

According to the Halifax "Guardian" that town has been the scene of an Anti-Vaccination riot.

P. P. Dehérain ("Annales Agronomiques") finds that during germination young plants absorb a considerable quantity of mineral matter. Calcium ulmate seems to have in this respect a particularly favourable influence.

Dr. H. Winnacker ("Naturforscher") has made a particular study of the vegetation of sewers and of drainage channels. He finds that the Algæ which are harmless flourish best in channels which are constantly traversed by clean water. On the other hand, the Schizomycetes (including *Micrococcus*, *Bacillus*, *Spirillum*, and *Bacterium*) which are dangerous flourish in water-courses which are alternately wet and dry. A green deposit is a favourable sign.

For the normal eye every point of the spectrum appears with a different colour. For the colour-blind there are certain points in which they obtain the sensation of whiteness, because at these points the two colour-sensations which in them exclusively predominate act with equal intensity, and produce the sensation of whiteness. Herr A. König ("Verhand. Berlin Physik Gesells.") has determined this neutral point in a number of cases by means of a special apparatus. He considers that the cause of colour-blindness lies in a more or less complete coincidence of two of the three curves of primary sensibility.

M. Aug. Charpentier ("Comptes Rendus") considers that from the point of view of perception we must recognise two very distinct groups in the series of colours. The *warm* colours are distinguished from a colourless ground more easily than white, whilst the *cold* colours are less readily distinguished than white.

Professor Jäger, the "soul-smeller" (*seelen-riecher*) as he is familiarly called in Germany, delivered lately a lecture on the necessity of wearing animal fibres alone next to the skin, rejecting cotton and linen even for the linings of garments. Many passages of the lecture are said to have occasioned general cheerfulness.

Professor J. W. Spencer ("Kansas Review of Science") maintains that in the earlier portion of the Quaternary Age, the Mississippi was very much larger than at present, having in the lower part of its course an average width of fifty miles, and received the drainage of Lakes Superior, Michigan, and Winnipeg.

We observe that "right-handedness" extends very far along the animal series. Parrots hold their food by preference in the right foot, and, though we cannot speak positively, wasps, beetles, and spiders seem to use the right anterior foot most commonly.

To our non-professional mind the projected establishment of a new hospital for North London seems a step of doubtful wisdom in face of the financial difficulties with which the existing medical charities have to struggle.

M. V. Babes ("Comptes Rendus") has made a comparative study of the bacilli of leprosy and of tuberculosis, and finds that the distinctions indicated by Dr. Koch do not exist, but he points out, in their place, other differences.

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THE
JOURNAL OF SCIENCE.

JULY, 1883.

I. WASTE.

SOME time ago it was the fashion to extol the wonderful economy of "Nature." Did she not, in her anxiety to leave nothing unutilised, put ten plants or animals where there was only room, light, and nutriment for two or three? Did she not make the most of space by peopling both the outer surface and even the interior of animals with parasites? Did she not break up her products the moment their life had ceased, and use the materials over again, thus setting man an example which he as yet but very imperfectly follows?

Yet whilst fully admitting these and many other instances of thrift in Nature,—some of them carried out to the sore discomfiture of the beings wrought upon,—not a few minds have come to recognise an accompanying outlay of material and of power which from a human point of view is simply profligate. Men are actually beginning to write and speak about the extravagance of Nature. By way of exceptionally adopting a new fashion let us, too, consider the wastefulness so strangely and in seeming inconsistency mingled with parsimony. Is Nature in certain respects lavishly prodigal, expending means out of all fair proportion to the end to be produced?

Our notice is first drawn to certain facts connected with the propagation of plants and animals. We find that eggs, seeds, germs are produced in such abundance that not a tithe, not a hundredth, of them can possibly reach maturity. Of these seeds and ova the vast majority never germinate, never come to life at all. Many are devoured by predatory animals; and inasmuch as all are nourished by organic matter, all animals are predatory. Many are destroyed by unfavourable circumstances, by extremes of temperature, by deficiency or excess of moisture. A fish deposits its spawn in stream or pool, and the water dries up in a rainless season ; or a violent flood conveys the spawn along with the mud or sand away over the fields, and when it retires leaves them to perish. Of the seeds and germs of the vegetable world it is no exaggeration to say that only a fractional minority comes in contact with the soil at all. Numbers fall or are driven upon the leaves or stems of other plants, where it is impossible for them to germinate. Others fall upon surfaces of rock and stone ; others again reach the soil, but where it is unsuitable in quality or in situations where their growth is rendered abortive by dense shade. An incalculable number of the seeds of land plants perish by being driven into rivers, lakes, and seas. More striking still is the waste of pollen, the male reproductive element of plants. In a great class of the vegetable kingdom, the so-called anemophilous plants—of which the grasses, the sedges, the firs, and pines are instances—this pollen is conveyed to the female organs of the species by the agency of the wind. Every particle which falls in any other situation is wasted. If we expose in spring-time, when such plants are in flower, plates of glass coated with glycerine, and afterwards examine them with the microscope, we recognise grains of pollen of many species. Thus we have proof that this fertilising element is distributed quite promiscuously. Hence if the flowers are to be fecundated the supply of pollen must be indefinitely greater than what would be sufficient if every grain were conveyed to the place where it is wanted. It has further been remarked by botanists that this waste has increased and is increasing. In other words, many plants, such as the grasses and sedges, formerly fertilised by the aid of insects, have become anemophilous—wind-fecundated—by a process of degeneration.

Believers in competition or "natural selection" may here perhaps urge that the destruction of seeds, germs, or ova, which we have just described, is but a part of the process which eliminates the individuals least fitted to survive. This, however, is not the case : when the seed has germinated, when the egg is hatched, the stronger and healthier young plant or animal may have a certain advantage as compared with its less vigorous and healthy rivals. But whilst the ovum or the seed remains such the chances of survival depend on no inherent attributes, but on purely external agencies, such as, for want of a better name, we are forced to call accidental. A hundred seeds may have been produced by a most healthy plant, and they may have been matured by the most favourable weather; but all this will not in the least secure them from being devoured by birds, nor will it aid them in finding a patch of fertile soil. Precisely similar is the case with the eggs of animals. Thus we see that the first great process of elimination, which proscribes the many and lets the few survive, takes and can take no account of relative fitness or unfitness.

We may ask here what becomes of the pollen-grain which fails to come in contact with the stigma of a flower of its own species? what of the seed which never germinates, or of the egg which is never hatched? Most of them will sooner or later be devoured; some will putrefy, and contribute in their small way to the fertilisation of the soil; but it may well be asked whether this is a sufficient reason for the production of an excess of elements chemically and physiologically adapted for the perpetuation of animal and vegetable life. The soil, it appears to us, might be manured more cheaply; animals might be fed at a less outlay of energy and material. That the seeds of plants should serve as the food of animals seems in many respects to have been especially guarded against by Nature. Witness the number of species where the seed itself is enclosed in a shell, hard, prickly, indigestible, or of disagreeable taste; yet, whilst thus guarding many seeds from mishap, she produces them under circumstances where their ultimate germination is a work of chance. Again, it is well understood that the secretion of the sexual products is no slight demand upon the resources of the adult animal. In many species the male is exhausted by a simple act of fecundation, and the female dies almost immediately after depositing her eggs. Why should a task be laid upon them a hundredfold greater than really eventuates in the birth of the next generation? There is here, surely, if not direct waste, nothing that can rank as economy,—no attempt to produce the maximum effect, or at least the effect needed at a minimum outlay.

In close connexion with this part of the subject comes the reproduction of the feeble, the deformed, and the diseased. If we glance over the whole of the organic world we find in every species a wide range as regards strength, vigour, and approximation to what may be called the physical type of its kind. We find such differences prevailing not merely in man, in tame animals, and in cultivated plants, but among wild individuals. Now we may safely conclude, or rather we learn from experience, that the offspring of feeble and diseased plants and animals inherit the parental shortcomings in a heightened degree ; yet we find too often that bodily superiority in animal or plant is not necessarily accompanied by marked fecundity, and that, on the other hand, debility and sterility are far, very far, from keeping equal step. Who has not seen a mean, shabby, little oak tree,—a vegetable hobgoblin, and living libel on its species,—yet literally covered, season by season, with acorns ? Who has not observed that, in our own species, the scrofulous and the phthisical have often more numerous families than the healthy and the robust ? Now if, in accordance with the principles of heredity, the diseased tree or the diseased animal reproduces its like, we have here a case of waste. The young trees or the young animals sprung from such parentage will perhaps—and this is the best case—not reach maturity. In the struggle between species and species, or between individual and individual, they are soon trodden down, and are in the meantime simply an encumbrance. The food they consume and the space they occupy might have served a better purpose. And circumstances may sometimes make them a more important obstacle than their intrinsic powers might seem to warrant. An acorn of the miserable little oak tree we have been picturing may perchance fall into good unoccupied soil, whilst the fruit of the "Major-," the "Shambles-," or the "Parliament-" oak in "merrie Sherwoode" may be devoured by squirrels or be carried off to feed swine.

Not merely the progeny of the debilitated, but every animal and plant which fails to reach maturity, may be said to be an instance of waste. Especially is this the case in the human species. The world would be immensely the wealthier, as well as the happier, if all those multitudes of children who die before reaching maturity had never been born, and if the cost of their nurture and education could have been capitalised.

We turn now to a very different region. The importance of combined nitrogen—as distinct from free gaseous nitrogen—is beyond all dispute. It is a most important part of the food of plants, without which their growth, or indeed their life, is utterly impossible. From plants it is transferred to the animals which directly or indirectly feed upon them, and forms a most essential constituent of their blood, their flesh, their eggs, &c. In short, we may say that without combined nitrogen life—as it exists in this world—is simply impossible. Further, the stock of combined nitrogen present elsewhere than in plants and animals is by no means unlimited. The atmosphere, the waters, and the soils have all been carefully analysed to determine their proportion of this constituent, but everywhere it has been found in very small quantities—mere traces. Thus, according to Fresenius, one million parts of air contain as an average only 0·133 part of ammonia. So that, roughly speaking, seven million pounds of atmospheric air contain 1 pound of ammonia. The combined nitrogen present in rain-water ranges from 8 to 65 parts in ten million parts. Again, not merely is the existing store of combined nitrogen thus very small, but we find hitherto no efficient provision for its increase or renewal. It was formerly believed that plants—some plants at least, such as clover, lucerne, peas, and beans—had the power of seizing the gaseous nitrogen of the air, and converting it in their tissues into ammonia, nitrates, or into organic compounds. Careful series of experiments, carried on in many cases in the hope that this might be true, have given, however, a uniformly negative answer. If we plant seeds in soil free from combined nitrogen, and pass over them only such air as has been carefully deprived of ammonia or nitric acid, we find in the dwarfed diminutive shoots which spring up no more combined nitrogen than preexisted in the seed. A repetition of such experiments, under every variation of circumstances, has driven both scientific chemists and practical agriculturists to the conclusion that plants cannot assimilate or feed upon the free nitrogen of the air. As for animals, they have not even the least pretensions to the power which we find plants do not possess.

Nor have we been able to trace in the inorganic world any processes which meet the difficulty. Even the small proportion of ammonia found in the air is certainly in part—and we do not know in how great part—derived from the decomposition of animal and vegetable matter. We know that nitrogen can be made to combine with oxygen by electric sparks, or in other words by lightning. It has also been ascertained that the so-called effluve, or silent electric discharge, can induce the combination of nitrogen with hydrogen, thus forming ammonia. But these processes are exceedingly slow and little productive. It has lately been established that at great elevations in the atmosphere they are even less active than near the earth's surface. Thus water obtained from snow collected at high elevations in the Alps contains, according to M. Boussingault, no nitric acid, and in some cases no ammonia, the maximum proportion of the latter, at heights exceeding 3000 metres, being 1 part in ten millions.

We may therefore sum up by saying that combined nitrogen is indispensable to animal and vegetable life; that the world's stock of such combined nitrogen is relatively small; and that the processes for its increase or recovery are tedious, and not active. Surely we might, under these circumstances, expect that if Nature were a consistent economist she would most carefully watch over her supply of combined ammonia, and guard against its decomposition. Such, however, is not the case. M. J. Reiset has recently shown that a part of the nitrogen contained in the albumenoid matters of animals is set free during the transformations going on in the body, and escapes as gas. When the liquid and solid excretions of animals enter into putrefaction a part, indeed, of the nitrogen present reappears as ammonia or as nitric acid. But another portion is liberated, and takes the form of free nitrogen. A striking instance of this waste is seen in the case of sewage. Knowing the rain-fall and the water-supply of a town, and the amount of its population, we can form an approximate calculation of the quantity of nitrogenous matter which such sewage ought to contain. But if we then submit a sample of such sewage to analysis we shall find the result falls greatly below the most moderate estimate. From 20 to 50 per cent of the combined nitrogen originally present in the excreta has escaped in the free state, and has been wasted. In the "Journal of Science" for 1878 (p. 145) we discussed man's sins and shortcomings as regards the economy of nitrogen. We see now that Nature is guilty of waste of the very same kind.

It has lately been forced upon our attention that the permanent and decided enrichment of a soil by manuring is, as regards the nitrogenous constituents, difficult, if not absolutely out of the question. If we mix with the earth guano, blood, fish, or other nitrogenous matter, a rapid series of changes takes place. Not only does a part of the combined nitrogen escape in the free state, but the rest, under the influence of ferments present in the soil is rendered soluble far more rapidly than it is required or can be utilised by the growing crops, and is washed down and carried away in the drainage-water, passing ultimately into the sea. We have, indeed, no reason to suspect that it is in this process decomposed, but its immediate utilisation on the earth's surface is suspended. An enlightened economy condemns in man not merely the actual destruction of any useful matter, but its being locked up in an unavailable form, or, figuratively speaking, its withdrawal from circulation. The miser of the old school, who buried his gold beneath the floor of his house, is pronounced a bad economist: had he, instead, invested it judiciously he might have become a much wealthier man. The fact that sooner or later the hoard is discovered and utilised does not cancel his error. Just in the same manner Nature has withdrawn from circulation a considerable part of her capital, and has kept it in such a state as to take no part in the transformations on which animal and vegetable life depend. The coal-beds, carboniferous and oily shales, &c., consist of the relics of vegetation which have been locked up for thousands of years in an inactive condition. We refer here not to the carbon and the hydrocarbons present, since carbon and hydrogen are elements so abundant that Nature has small cause to practise thrift as far as they are concerned. But coal, lignite, and their kindred minerals contain nitrogen in the combined state, sometimes in proportions exceeding 1 per cent. All this combined nitrogen, which in an article so plentiful as coal amounts to a prodigious quantity, has been for unknown ages rendered practically non-existent.

But it will be contended, in reply, man has, during the last few centuries, found these deposits, and is utilising them! True; just as the treasure-seeker sometimes finds the buried hoard of the miser or the pirate, and brings it more or less rationally into use. The discovery may be exceedingly convenient to such treasure-seeker, yet none the less the miser or the pirate was a bad economist. Why should Nature be judged differently.

We turn again in a totally different direction. Suppose that there exist a number of different machines or appliances whatsoever for executing one and the same task. Suppose, further, that these contrivances differ much among themselves in their relative degree of excellence and efficiency. We may take, for example, the boomerang, the sling, the bow, the match-lock, the flint-lock, the muzzle-loading rifle, and the breech-loader. Or, as another instance, let us compare, as means of transporting merchandise, the pack-horse, the stage-waggon, and the goods-train. If a manufacturer employed, and continued to employ, all these three kinds of conveyance for transporting the same kind of goods to the same place, he would not unjustly be pronounced a bad economist. Yet this is precisely what Nature does. We find her employing a number of different agents to effect some one purpose, and she even gives a preference to those which work in the least satisfactory manner. Thus we see the removal of putrescent and excrementitious matter committed to a number of beings who proceed on very different principles. Some, such as the dung-beetles and sexton-beetles, bury the offensive matter in the earth, so that its odours and other exhalations are absorbed by the soil, and cease to be a nuisance. These creatures, moreover, prey on no other kind of matter, so that there is no fear of taint or disease being spread by their agency. Hence they may be called model scavengers. Others again, among which a great number of two-winged flies may be included, eat carrion and excrement, and deposit their eggs in it, but leave it on the surface of the earth, and for the time being intensify its putrefaction. Further, these flies do not confine themselves to putrescent matter, but settle upon and feed on a great variety of substances, living or lifeless, and thus spread decomposition and disease. They are, in fact, the worst of conceivable scavengers. Where they remove one nuisance they occasion ten. Yet Nature employs them, it would seem, in preference to the perfect sanitary workers previously mentioned. In preference, we say, because the bad workers seem to become more plentiful, whilst the perfect workers are losing ground.

We have thus attempted to give not a catalogue, but merely a few instances where Nature does not appear to act according to the principles of economy, but rather of carelessness and waste. On what system such prodigality is intermingled with a parsimony so extreme as in some cases to defeat its own ends, we are unable to explain.

II. SOME ETHNOLOGICAL OBSERVATIONS.

By Cl. de Crespigny.

HAVING read somewhere that Jewesses in Eastern Europe have their heads shaved at marriage, and ever afterwards wear wigs, it occurred to me that this might be a custom derived from the Ancient Egyptians, who we know wore them habitually,—perhaps that when in private they might, by taking them off, enjoy more coolness than if they wore their natural hair.

Having read in your Journal that the Australian aborigines are in the habit of burying their excrements, I remembered a sojourn of fourteen months once endured by me in St. David's Islands, off the north coast of New Guinea. The inhabitants were in all eight, *viz.*, two old men, two young men, one old woman, one young woman, who was a widow with two children—daughters. These people buried their excrements in the sands of the sea-shore. Another very peculiar custom I observed was that the widow, once a month, when her times were upon her, was considered unclean, and went to live for a few days with her two children in a hut near the beach, just within shade of the fringing cocoa-nut trees. Her friends brought food every day, and enquired after her health, but did not approach to within a few yards of her, nor would they, even while she was in retirement, pass between her and the sea. Even if walking on the beach they would, on approaching her hut, make a *détour* within the trees, coming out on to the beach again on getting past the hut.

There were some graves in which they said were deposited the bones of chiefs (the islands had formerly been more populous). They said that they hove into the sea, beyond the surrounding coral barrier, the corpses of common people. I asked if they had any idea that their dead friends would live again? and they said "No, pitch 'em overboard, and there's an end of them."

These people, although they lived in a group of cocoanut islands, did not know how to make oil, and were astonished at the brilliancy of my reading-lamp, fed with oil made on the spot by my servants.

The men had sometimes gone whaling for a few months, in ships which lay to off their reefs, and had acquired some phrases of English. Thus they called sunrise and sunset "sun up" and "sun down." In offering me a drink of toddy they would say "Put it out of sight." But they had not been taught to swear. I remember that the name of one man was Merriwitty, evidently from some sailor named Meriweather; that of another was Mollymock (? Dollymop).

They said that many years before a large boat, having in her about thirty men, had been blown from the N.W. to their islands. The strangers spoke the same language as they did. After a visit of about ten days' duration these people left again for the N.W. (I thought these visitors might be from St. Andrew's Islands), The St. David's people said they had never been in the habit of sailing anywhere, nor had they ever before, within the bounds of tradition, received visits from the N.W.

Some years before my arrival a large body of pirates had made a sudden descent on their islands, and carried off nearly all the inhabitants. Those who escaped did so by paddling out to sea, and remaining there some days, keeping the tops of the trees just within sight. This expedition, as I learnt afterwards, had been sent by the Sultan of Zidore, and was not considered by the Dutch as an act of piracy; and I believe some correspondence took place with the English Government in consequence of the late Sir Edward Belcher having been of a different opinion.

St. David's, or Free Will, Islands are—or rather the largest of them is—called Mapia.

III. OBSERVATIONS ON POLLUTED WATERS.

By J. W. Slater.

THE self-purifying power of polluted rivers, and still more of town sewage, has been the subject of no little discussion, and is still far from having been brought to a decision. I have, in a former volume of the "Journal of Science" (1881, p. 138), referred to the opposite conclusion, which has been reached by the late Royal Rivers Pollution Commissioners, on the one hand, and, on the other, by Dr. Tidy, and by a French chemist whose name has escaped me, but who made a very minute study of the waters of the Vesle, above, at, and below the town of Rheims.

The first-mentioned authorities,—perhaps we should rather say authority,—without declaring in general terms that a river once contaminated could not purify itself again, maintained that at any rate no such restoration was possible within the length of any river in the United Kingdom. Dr. Tidy is of a different opinion, and the French chemist above referred to gives an instance where the gradual change from purity to pollution, and thence back again to purity, may be seen by anyone who is willing to spend a day in examining the Vesle above and below Rheims. The alleged changes are the more striking as the Vesle is not a river of enormous length. If we allow thirty-six hours as the length of time required by a drop of water from the clean regions above the "French Leeds" to the clean regions below, we shall be on the outside of the truth.

To throw a little more light upon the subject I took three kinds of water: 1st, raw, undiluted sewage, which I obtained from Aylesbury; 2nd, similar sewage partially purified; and 3rd, sewage fully purified, as it passes from the works of the Native Guano Company into one of the branches of the Thames. The sewage in question is strongly animalised, containing, in addition to the usual excrementitious matters and liquid household refuse, a somewhat unusual proportion of blood, derived from the cattle slaughtered in Aylesbury for the London dead-meat market. What may be called industrial contamination is totally absent. Of each of these three kinds of water the one-half was filtered and the other left in its original state. I had, therefore, now six kinds of water in my hands. Of each of the six I placed portions, differing in bulk, in a number of white glass pint bottles, loosely stoppered, and arranged on a shelf exposed to the morning sun. In some of the bottles the stratum of water was 1½ inches in depth; in others 3, 4, &c., up to 6 inches. The bottles were now regularly examined to see what changes would take place. In the bottle containing the best purified water, filtered, and in a shallow layer, a green confervoid vegetation appeared in a couple of days; it increased, and bubbles of oxygen were formed and rose to the surface. There was no offensive odour. Similar phenomena were observed later in the other bottles; but eight weeks passed over before green vegetation appeared in the bottle containing 6 inches in depth of raw unfiltered sewage. In the meantime the odour given off from this bottle had been very offensive. It must also be remarked that in this bottle, along with the green confervoid growths, there appeared a small quantity of white sewage-fungus, which was only gradually burnt up by the oxygen liberated by the green vegetation.*

Hence it would appear that, according to common belief, the appearance of green vegetation, unaccompanied by white fungoid matter, is a favourable sign; that sewage can purify itself, but that the process is very slow; that the speed with which the impurities in a water are destroyed is greater where it is spread out in shallow layers to the action of air and light, and where its transparency is not interfered with by suspended matter; that the self-purification of sewage is of no practical value, since during the greater part of the process it is exceedingly offensive, and since to let it stand in shallow settling tanks would be ruinously costly.

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* This is the first time that I have watched the appearance of sewage-fungus in stagnant water.

The speed of purification would doubtless be increased no little if it were in motion instead of at rest. Further, not even the most polluted river contains the same proportion of impurities as the undiluted and untreated sewage used in some of the above-mentioned experiments. It will likewise be admitted that in a river, well stocked with water-plants, the oxidation of the impurities will be more rapid than where such vegetation has first to be developed. On the other hand, there are in practice circumstances met with which must interfere with the combustion of the organic matter held in solution. In the sewage of manufacturing towns and mining districts there may be poisons which prevent vegetation of any kind, chlorophyllaceous or otherwise. The great opacity of certain sewages will also retard purification by excluding the light.

Bearing all the above facts in mind, we shall find that the conflict between the authorities above mentioned is probably more apparent than real. There are many rivers in the manufacturing districts of England polluted to such a pitch that vegetation in them is impossible, and the great self-purifying agency is thus suspended. I can very well imagine that an analysis of the water of the Irwell, at its junction with the Mersey, will show the same impurities, and substantially in the same proportion, as are found in the river where it leaves Manchester. I should expect that the waters of the Aire or of the Calder will, in like manner, show no improvement in 10 or 15 miles from their most polluted point. I should expect this to be the case because the flora and the fauna of the water remain the same. But with the Vesle, at Rheims, the case is plainly different. We read of green aquatic vegetation reappearing below the town, and becoming more vigorous within the space of a few miles. Hence the means for the purification of the water being present, we need feel no surprise that the effect is produced. If Prof. Frankland had made his observations on the Vesle he would have come to the same conclusions as his French *confrère;* and if the latter had been sent to study the Mersey, the Irwell, or the Aire, he would in turn have given it as his opinion that there was no natural process by which their purification could be effected within the course of any British stream.

I come now to the second part of my subject: can fish live in sewage? It is somewhat curious that the affirmation should still be maintained. Perhaps the very first impulse to the movement for preventing the pollution of rivers in Britain was due to the observation that the contrary is the case. Said the riparian proprietor to the people of the town next above him on the stream, "Your sewage is destroying my fish,"—and this destruction has been one of the reasons why in such cases injunctions for the abatement of the nuisance have been issued. It will not do to say that the fish are killed not so much by sewage, properly so called, as by the waste waters of various factories. True lime, the hypochlorites, sulphate of soda, coal-tar products, and a long string of other bodies which find their way into our rivers, have played sad havoc among fish. But whoever will make careful inquiry will find that fish have also disappeared, though more gradually, where nothing but sewage —in the strict sense of the term—has found its way into the rivers. I have seen ("Journal of Science." 1881, p. 144) fishes darting about in the Thames at the spot where the Kingston sewer then opened, and I have heard that the locality was on this account much frequented by anglers. But I was also told that the fish caught in such localities enters into putrefaction with unusual rapidity. Hence, I think, it may be fairly argued that such fish are in a morbid condition, and that the circumstances to which they are exposed must sooner or later bring on their destruction, as we in fact find is the case in rivers where sewage pollution is great. As long as the volume of sewage is but small in comparison with the bulk of clean water, they will survive, and will visit the sewer outfall for feeding purposes, attracted by the larvæ of various kinds and by the particles of human food brought down by the impure water. But we have no evidence to show that this sewer haunting is conducive to their health or multplication. On the contrary, if we only observe carefully, we find that it is destructive to them, some species resisting longer than others. That excrementitious matter, *per se*, is avoided by fishes we have observations to prove. An intelligent Parisian *ravageur* states, in the "Moniteur Scientifique Quesneville," that fishes avoid any particularly offensive discharge of matter from the mouth of the sewer, and hide themselves among the weeds till the nuisance has passed. I have observed from time to time, and in different places, shoals of minnows playing about the mouth of a sewer, but on careful examination I have rarely failed to note some dead specimens floating on the surface.

It is very plain, on theoretical considerations, that sewage, or water containing a large proportion of sewage, must be fatal to fishes as a medium for constant residence. We know that they breathe not the oxygen existing in combination with hydrogen in the water, but the free oxygen which has been dissolved in the water. It has been found that fish quickly perish in water which has been boiled and allowed to cool in a closed vessel without agitation. Now in sewage, and in sewage-polluted river-water, it is analytically demonstrable that the proportion of free oxygen is very much reduced. The various kinds of organic matter undergoing rapid changes use up the available oxygen, and unless aëration is effected by rapid motion, or by the action of water-vegetation, fish are in the same condition as a man would be if placed in a highly rarefied atmosphere. In consequence they must either retire from the danger or ultimately perish.

It must not be supposed that this deprivation of free oxygen is the only reason why fish are unable to survive in polluted waters; but it is a cause readily demonstrable, and one which cannot fail in its action. But many of the agents employed by individuals or by communities, for lessening or preventing the offensiveness of sewage, render it even more destructive to fish. It is known that not a few sewage processes employ lime, not merely to correct the acidity sometimes met with in industrial waste waters, but as a positive precipitant. I know of a case where 16 tons of quicklime have been put daily into the sewage of a single town, unaccompanied by any corresponding dose of an acid or of an acid salt. In all such cases the effluent water has a faint alkaline reaction; it is, in fact, weak lime-water. Now everyone surely knows that lime is hostile to fish, and indeed to water-vegetation. By putting a few lumps of quicklime into a stream, poachers often succeed in killing the fish for a considerable distance. We must therefore readily admit that where the introduction of lime is continuous, fish cannot prosper. It may be argued that lime-water on exposure to the air becomes harmless, all its lime being converted, by the carbonic acid of the air, into calcium carbonate, in which state it is very sparingly soluble; but when the quantity of lime-water introduced into a slowly-flowing river is great and continuous, the water must travel for many miles before this conversion can be effected. Hence I can but advise riparian proprietors, lessees of fisheries, and brethren of the angle to set their faces against all sewage processes in which lime is used, either alone or without its equivalent of an acid or acid salt.

All these processes are to be condemned, from the same point of view in which salts or other compounds greedy of oxygen are run into the rivers. Ferrous sulphate, or copperas, ranks among these agents. In like manner any alkaline or earthy alkaline sulphide, or any compound from which sulphuretted hydrogen can be evolved, should be used in the treatment of sewage. Such substances not merely rob the water of its oxygen, but act as positive poisons.

IV. POLYDESMUS COMPLANATUS.

By A. H. Swinton.

AT a late meeting of the Entomological Society of London, Professor Westwood stated, as an item of Economic Entomology, that the myriapod *Polydesmus complanatus*, L., had been gravely accused in a Sussex newspaper of being the cause of the potato disease.

Observing a paragraph headed "The Cause of the Potato Disease," in the "Sussex Gazette," on the 23rd of last March, I was led to inquire into the nature of this startling announcement. The writer, Mr. Jesse Page, an agriculturist of the sister county, very obligingly took me into confidence, and explained that he was under the conviction that the mischief among his potatoes arose from the presence of a mysterious insect, whose habits he had been watching these thirty years past, and which as yet no one could be found to publicly name. The following humorous extract from his communication on the subject will sufficiently explain the views he had been led to adopt:—"I got out into my garden yesterday for the first time, where I had a man digging ground which had been planted with potatoes all the winter. I searched for some time, and then I found two insects evidently intending to breed there. And this is the beginning of my theory. The insect breeds in the old set, and wisons it, and causes it to rot prematurely, and when the potato dies people examine the haulm to find out the cause."

As mutual assistance is imperative with those who desire to turn natural science to account, I drop a friendly line to my new correspondent, offering to co-operate with him in his researches, and to render him any aid that lay in my power. Expectation stood tiptoe for a day or so, and then there comes a little box by the post, enclosing some carefully hoarded fragments of the insect in question, with further intimation that live examples would follow by the carrier. A glance at the enclosure showed me that my correspondent was correct in his assertion that the marvellous insect was of the myriapod class, and on reflection it occurred that the only party who was likely to have bestowed much attention on this order would be Prof. Westwood, and to him I decided to refer the matter.

A few days went by, and I received a reply to say that the insects supposed to be the cause of the potato disease were without doubt the *Polydesmus complanatus*, one of the Myriapoda. The Professor, however, deprecated their being supposed the cause of the disease, and added that he had no doubt but that they might be found in diseased potatoes, just as a score of other insects of different kinds, concerning which the French writer Guérin gave an account, in 1845, in his "Memoire sur les Acariens, les Myriapodes, les Insectes et les Helminthes, descrivées jusqu' ici dans les pomme de terre malades." The *Polydesmus*, I should perhaps observe, is a pale whity-brown insect, which must be familiar to most potato-growers. Though a centipede in form, it has only seven joints to its feelers or antennæ, and it is therefore more nearly akin to the wood-louse and cylindrical myriapod than to the brown centipedes and Scolopendras of the tropics, which have fourteen.

The potato disease, as is well known, is due to a fungus or mildew called *Peronospora infestans*, and I gather the following particulars concerning its spread from an article by a relative of mine, Dr. Galbraith, of the Stirling Natural History and Archæological Society, who has made a speciality of the matter :—The spores or capsules of this mildew are of two kinds, and they have the marvellous property, when moistened, of absorbing the moisture and bursting, by which means numerous living seeds—if it be permissible to so translate the learned term applied to them—are set free. These living seeds or zoospores move about by means of their fringes or cilia, and germinate within from an hour and a half to three hours after the spores are sown. One of the two kinds of spores or seed capsules hybernates or remains dormant throughout the winter season, and these propagate the disease from year to year.

The same authority adds—"I frequently find diseased potatoes at the root of the most flourishing and healthy-looking shaws. As to the potatoes, I have seen very few of them pass into a state of moist corruption; neither have I been struck with an offensive smell given out by the plants, which, however, counts for little, seeing the olfactory sense varies. The tubers affected are easily recognised by the dark spots on the skin. If this is scraped off the subjacent tissue is seen to be of a brown mottled colour, which permeates more or less extensively the naturally white flesh of the potato. When extensively diseased the potato loses its natural smoothness and colour, and is converted into a dark, rough, heavy mass."

Although competent microscopists, by the plan of hanging up wetted sheets of paper and afterwards submitting them to the microscope, have conclusively proved that the air around us is full of all manner of floating spores, I would have willingly credited my correspondent's assertion that the mysterious myriapod might be guilty of spreading the infection. However, putting the matter to test, and enclosing the said myriapod with a choice example of a Sussex kidney, I then discovered conclusively it would not touch it, and that its nature was to prefer decaying leaves, agreeably to the taste of its kind and the remark of Prof. Westwood, that "the Myriapoda delight in decaying vegetables." Afterwards I introduced a couple of earwigs on the scene, and these, indubitably the more mischievous of the two, soon riddled and fairly consumed the potato.

But to return to the main point. It is evident that moisture is necessary to extend the evil of the potato disease, and consequently there is less fear of it when the summer is hot and dry than when the season is characterised by much moisture, and more particularly moisture accompanied with warmth, when myriapods doubtless abound. It has also been observed that thunderstorms, with the usually concomitant rain, are sure to be followed by an active development of disease among the potato plants.

Though the potato was introduced into Lancashire from Virginia, in America, by Sir Walter Raleigh, about the year 1586, the disease is stated to be quite a recent importation. The year 1846, that followed on its first invasion, was the worst year known: 1860 was likewise a bad one; and it was bad in Ireland from 1876 to 1879: then last year it was said that the growers of potatoes were everywhere at their wit's end. Certainly this spring potatoes in Surrey have been proverbially bad, and villanously "dark, rough, and heavy." Where the disease came from appears not to be distinctly known: the potato crops of Belgium suffered from it in 1842, and in 1844 it was noticed in the United States of America and in the Isle of Wight.

Now it would be hardly imagined at first sight that, supposing a wet year—or, as growers say, the rains that come between June and the close of October—be proved to bring about a state of matters favourable to the spread of the potato disease, we could thence argue the probable periodicity of its recurrence. There is, however, a growing feeling among our first meteorologists that we have all along been ignoring the sun's influence over the rainfall and the growth of vegetation. Certain is it that the sun blackens over with spots about every eleven years, and three or four years previously to this spottiness it is at its brightest. To these sun phases, as Mr. Norman Lockyer has lately officially stated, "the rainfall of our globe has been in measure determined to respond." No marvel, then,—when we discover that in 1846, 1860, and 1882, the sun was very much spotted over and the potato disease very rife,—we should entertain qualms about 1890 or 1900, when we may expect the spots back again. The visitation of the potato disease in Ireland from 1876 to 1879, on the other hand, corresponds with the period of solar clearness preceding 1882, at which times there is evidence to show that the summer rainfall is often in excess.

Lastly, when speaking of these phases of fitful brightness and spottiness of our day-star, and their appointed rule over mundane affairs, I might allude to an interesting theological scientific discussion that has taken its rise with the sun-spot year of 1882. Early this spring my friend Mr. Kirsop, of the Glasgow Natural-History Society, knowing me to be interested in Solar Physics, favoured me with the following newspaper-cutting, headed "The Star of Bethlehem":—"A recent telegram from a Berlin correspondent mentioned that the Star of Bethlehem was predicted to reappear during the current or next year. The prediction is based on the supposition that certain stars of the class known as 'temporary' are simply reappearances of the same orb. Pliny mentions that the sudden appearance of a bright star, which after a time vanished again, led to the formation of the first catalogue of stars, which was compiled by Hipparchus. This statement is corroborated by the Chinese records, in which the rise of a new star in the constellation Scorpio is mentioned in the year 134 B.C., nine years prior to the date of Hipparchus's catalogue."

To this Virgil probably makes reference in the well-known lines :—

> " Anne novum tardis sidus te mensibus addas,
> Quâ locus Erigonen inter Chelasque sequentes
> Panditur : ipse tibi jam brachia contrahit ardens
> Scorpius, et cœli justâ plus parte reliquit."

" In the year 389 A.D. a star appeared near Altair, which remained visible for three weeks, rivalling the planet Venus in splendour. The next orbs of this class of which we have accounts are those mentioned by our correspondent, namely, those of 945, 1264, and 1572. Accounts of the 945 and 1264 are very vague, but it is known that the stars were located near Cassiopeia. The star of 1572 was observed by Tycho Brahe, the celebrated Danish astronomer, who devoted 478 closely-printed pages to its description. Tycho's attention was drawn to the star, while passing from his laboratory to his dwelling (on November 11th, 1572), by some peasants who were gazing at it. At the time of discovery its brilliancy equalled Sirius (the dog star), and it went on increasing until it surpassed Jupiter and Venus, and ultimately became visible at mid-day; then it gradually faded away, passing out of sight in March, 1574. During the previous seventeen months its position was unaltered, but it is said to have changed in colour from white to yellow, red, and white successively. There is now a very small star within a very slight distance of the position recorded by Tycho, and, from the observations of Messrs. Hind and Plummer, its light appears sensibly variable. Very bright stars also appeared in 1604 and 1670 : the former, in Ophiuchus, lasting over a year, and being at times nearly as bright as Venus ; the latter, in Cygnus, lasted two years, during which it reached the third magnitude, faded away, and shone forth again on more than one occasion prior to its final disappearance. During the present century similar luminaries have been observed to attain an unwonted degree of brightness, and then fade away until only the most powerful telescopes can detect any trace of them. A comparison of the dates given (945, 1264, 1572) shows a difference in the period which our present knowledge cannot account for, but astronomers of a future generation may possess information not at the command of those to-day, and thus account for that which to us is veiled in mystery."

The next notice of the Star of Bethlehem caught my eye in " Science Gossip " for May, the writer professing himself credulous on the subject. He says—" The American papers are discussing the expected reappearance of this star, which will be seen in the constellation Cassiopeia about August, 1887. It is said to be the same star that appeared at the birth of Christ, and only appears once in 312 years. It is not to be supposed that astrologers would allow so extraordinary a phenomenon to pass unnoticed, and many prodigies may be expected to occur." In the number of the same publication for June a member of the Astronomical Society reviews the religious aspect of the belief. He disposes of the supposed star of 1264 as the splendid comet seen the year of the battle of Lewes, and mentioned by all the historians of that period. "And with regard to the Star of the Nativity nothing can be more evident, as was pointed out by St. Chrysostom, than that it was a miraculous appearance in the form of a star (perhaps visible, as many divines think, to the Magi only), sent expressly to indicate the Saviour's birth." In such a case, however, we have St. Jerome and the authors of the Revised Text brought into strange conflict; for not only the words "in the likeness of" do not occur, but Herod is represented as enquiring of the Magi concerning the time of the star that appeared. Again, since Bethlehem is only 5 miles distance from Jerusalem and a trifle to the westward, I conclude that there is no paramount reason that a strange star should not go before the Magi. A certain sensational painter, however, has priority in such matters, as a well-known print has long flared in the bookseller's window, where the Star of Bethlehem is depicted as something between a bombshell and a comet.

V. THOUGHT READING.*

By Rev. H. H. Higgins, M.A.

THE limited time at my disposal induces me at once to state my belief that the process known as "thought reading" is characterised by genuine phenomena which are in perfect accordance with the natural laws recognised in the science of Mental Physiology.

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* The substance of this article has been read in a paper before the Philosophical Society of Liverpool.

We have a mere secondary interest in the multitude of complicated adventitious circumstances usually attending a popular exhibition of thought reading. Such circumstances form the staple of the observations and remarks ordinarily made on the subject. The very simplest case is best suited for our purpose, and one *true* example is as good as a thousand.

I will endeavour to define what I understand by thought reading, and then to show that its exercise is compatible with scientific principles. The individual who undertakes to read the thoughts of another is called the operator; he whose thought is read is called the subject. I will call the operator A, and the subject B.

If A know the thought of B by an impression, ever so subtle, received through any of the senses, such as touch, sight, or hearing, then A's knowledge is not gained by thought reading, though B may be perfectly unconscious of having afforded an intimation of his thought to A, in any way whatever.

Probably such accessories to apparent success are used by certain public operators so as in a wonderfully keen and sagacious manner to avoid failures. I have no doubt that there are others who are altogether above such trickery. Of course there is a *rapport* of some kind, or the thing would be a miracle. If it be always a sense impression, thought reading must, I think, be classed with table-turning. But if A, guided by no sensuous impression, can, through *quasi* electric relation with B, proceed to say or do something having an unmistakable affinity with a thought entertained by B, but otherwise unknown to A, *that* is thought reading, of which I shall attempt to show the reasonableness.

All of us remember table-turning. Many men of science said " The whole thing is an imposture, not to be explained but scouted." If it had been left to these men table-turning might be in vogue now. For in spite of the thing being scouted, the tables *did* turn, no one knew how. For table-turners were not all impostors, but were themselves deceived. Faraday gave a scientific explanation of the fact, and table-turning died a natural death through atrophy.

I am far from anticipating such an end for thought reading, which may possibly prove to be of some remedial value in certain forms of insanity.

There are, I conceive, called into exercise in every instance of thought reading, two distinct constituents,—first, the ordinary nerve currents; and secondly, an abnormal exaltation of the sensitiveness of some portion of the cerebra system, or sensorium, of A.

First, then, as to the currents. There is no need to invoke the aid of any special psychic or odic force. We know that between the brain and every part of the body a most intimate connection is kept up by means of the nerves, along which, as along telegraph wires, currents continually pass and repass. The word current is misleading. We must not suppose that matter of any kind is transmitted; neither is nerve current exactly a wave motion, but it is rather a succession of impulses. Professor Clifford compared nerve current with the motion in a row of card houses, when the end house is shoved against the next. The fall of the whole series is very satisfactory to see, the only drawback being that all the cards must be put up again before the experiment can be repeated.

It seemed to me essential that you should form a clear conception of motion along a line without transmission of anything. I therefore reconstructed from memory a toy which was a great favourite with me about sixty years ago, and which may be qualified for introduction to a scientific meeting by being named a "statoract."

It is plain, then, that very active motion may be set up along a line without a particle of matter being transmitted. If you will be so kind as to imagine the plaques of wood to be magnified molecules, you will the better appreciate Prof. Clifford's remark on nerve currents. He says that if we could magnify the molecules 50,000,000 diameters, we might see them falling one against another; but he warns us that we should not, even in that case, be any nearer seeing thought or consciousness.

Nerve current is very similar to that of electricity, but the two are not known to be correlated or convertible, though nerve current is said to be always associated with electric current.

In Dr. Rosenthal's account of M. E. du Bois Reymond's experiment, in which the index of an electrometer is made to move by an effort of the will, it seems probable that electricity, thus associated, is the agent.

I have not space to dwell upon the points of resemblance between nerve current and electricity (see "Muscles and Nerves," Dr. Rosenthal, International Series; Kegan Paul). But the fact must not be passed by that there is a special physical condition of the brain corresponding with every thought of which we are conscious. During every sustained thought nerve current is acting in a peculiar way in the brain, and probably affecting nerve current in the hand and over the whole body. I see a man standing on the weathercock of a tall spire, and my knees knock together. This affection of the nerves, controlling the muscles of the knee, is not dependent on volition; therefore it may be regarded as a constant fact that a brain condition affects, with greater or less intensity, the nerves over the whole of the body. Here arises what is perhaps the critical question of the whole enquiry.

B is conscious of a thought: simultaneously he has in his brain the physical counterpart of his thought. Is it possible for that physical counterpart to be communicated to another individual, independently of impressions made through the senses? We have now advanced a stage. We have left the metaphysical region of thought, and have turned our attention to its physical counterpart in the brain.

When I say the counterpart of a thought I mean a corresponding physical molecular condition in the brain. If B see a peacock, the image of the bird gets no further than the retina of his eye. Anything less like a peacock than its molecular counterpart in his brain can hardly be conceived. If, in the absence of the bird, B voluntarily think of a peacock, the respective physical counterparts, of the sight impression and of the voluntary thought, will be identical, or sufficiently alike to be identified. If, now, the counterpart in the brain of B can be reproduced in the brain of A, A will think of a peacock, and so solve the problem of thought reading. I will now quote some words of Dr. Carpenter ("Mental Physiology," 6th edition, p. 633):—

"Looking at nerve force as a special form of physical energy, it may be deemed not altogether incredible that it should exert itself from a distance so as to bring the brain into direct dynamical communication with that of another, without the intermediation either of verbal language or of movements of expression."

Omitting much I would like to add here, I would say that, to use Dr. Carpenter's term, the dynamics of B's brain, when he is charged to concentrate his whole mind and keep it fixed on a single thought, must, I should suppose, be in a condition very favourable to observation. This kind of concentration is hard work, and, if prolonged, may be felt to the tips of the fingers.

Reverting to the remarkable resemblance between nerve current and electricity, it seems highly probable that nerve current can act at a distance. The phenomena of induction in electricity are too well known to require more than an allusion. Action at a distance may perhaps be said to be the grand distinctive feature of electricity, dividing it from heat and light, which act not, except through their proper media. Nerve current being a force bearing a wondrous resemblance to electricity, will there be no analogous phenomena of action at a distance in nerve current ?

What is the nature of nerve current ? We know not ; neither, according to Professor Tait, do we know the nature of electricity.

A wishes to know the thought of B ; how does he place his own nerve current in relation with that of B ?

The respective sensoria of A and B are not brought into juxtaposition, because externally the skull is not sensitive. Operators and subjects have sometimes been charged with laying their heads together : in such cases thought reading is of course metaphorical.

There are reasons why the hand should be used as the instrument for receiving the influence of the nerve current. It is extremely sensitive ; but, above all, the brain is well accustomed to acts of discrimination founded on nerve current coming from the hand. A, we may suppose, is blindfolded. Touch any other part of his body with a hazel nut, he is doubtful ; let it be brought into contact with his hand, he is sure. This is a sense of impression. True, but the brain is accustomed to judge what a thing *is* that sends up a message from the hand. The nerve current from the hand goes straight to the thalamus. No light is thrown upon the matter there. So the thalamus sends off the current, like a brush, to the grey cortex of the brain, where the current set up by the little hazel-nut is judged : not round enough for a marble ; not heavy enough for a bullet ; too hard for a little worsted ball ; and so forth, till the conclusion is reached : it is a hazel-nut : down comes a message to the striated body, to be delivered to the organs of voice—say aloud, " It is a hazel-nut." Such is the ordinary course of a sense impression from the hand.

Let us now dispense altogether with the presence of the tangible object, and suppose that instead of being excited by the touch of a hazel-nut, the nerves in the hand of A are excited by the nerve current in the hand of B whilst he is thinking of a hazel-nut. A's hand will send a nerve message to his brain. Of what kind ? Of no kind in particular ? Quite incredible. What should particularise it ? Its efficient cause, namely, B s nerve current, generated by a brain the physical condition of which corresponds with the thought of a hazel-nut. It seems to me highly probable that A would become more or less vividly conscious of an action in his brain, which he would be able to interpret as having its source in the thought of a hazel-nut.

The consideration of the second constituent in thought reading—the abnormal exaltation of sensitiveness in the operator, A—must not detain us beyond the time required for a brief allusion to the several stages leading by a perfectly natural gradation to the most highly exalted condition of receptivity. All our examples will be found to illustrate the amazingly extended principle of *compensation* in Nature. Take the case of a man born blind or deaf. The absence of a sense damages the integrity of his intellectual power: in spite of which the blind man often has his power of hearing wonderfully acute, and the deaf man often has unusually clear vision. Let us pass on to the ordinary condition of sleep. In sleep sense impressions are all suspended; reason, judgment, and even volition, are in abeyance; yet in sleep we become conscious of that delicate process which is ever going on, day and night, and which, when we are awake, *is* unconscious cerebration, or the phosphorescent action of the brain. It is unperceived during the day whilst the senses are active, being overpowered by their stronger impressions, just as the light of the stars is unseen in the clear daylight. The action of unconscious cerebration may sometimes be detected if we are suddenly aroused just at the first commencement of a doze. It is very delicious, and its interruption is exceedingly irritating. In sleep it passes into dreaming, which may or may not be agreeable. In the state of reverie the train of thought is more coherent, the senses are not wholly paralysed, we see figures in the fire, and the likeness of a whale in the cloud, or something else; but volition is wanting. In somnambulism volition is active; the senses also are in a normal condition; but reason and judgment are suspended, and the sleep-walker crosses a chasm by a narrow plank, heedless of the consequences of a fall, or works a sum in arithmetic vainly attempted during the distractions of waking hours.

All these states are perfectly natural: we attribute them to no mysterious agency; and though the parcelling out of the reason, the will, the imagination, the judgment,—now one and now another of these being suspended,—is very surprising, yet not more so than the phenomena in insanity. Yet sleep, reverie, somnambulism, and catalepsy lead up so closely to the hypnotised and mesmerised conditions that why the one class of affections should be less a subject for scientific investigation than the other does not appear.

The subjection of the will to the influence of a ruling thought is the great feature in all these abnormal conditions: it is often attended by extreme sensitiveness towards everything in connection with the ruling thought. The will is suspended in the subject, and the operator vehemently impresses a ruling thought on his helpless victim. All of us have seen the result a hundred times: I never can see it without a shudder.

Permit me now, in conclusion, to apply these considerations to the phenomena of thought reading recently exhibited in Liverpool, speaking of the operator, Mr. Irving Bishop, as A, and his subject as B. A wishes to show that he can read the thought of B. As far as possible A changes place with B. A becomes the subject, and will have B for his operator. A first secures that B shall have, for the occasion, a ruling thought, *e.g.*, the spot where he has hid the pin. B is to concentrate and maintain his thought on this one thing. As soon as A has made this provision, A throws off his own will by hypnotising himself. A becomes the helpless subject, and B with his ruling thought the strong operator. A knows that B *has* a ruling thought, but A has yet to find out what it is. A therefore puts himself in *quasi* electric communication with B, by means of the hand or the wire; but not with B's ruling thought, which is totally out of A's reach, but with its physical counterpart in B's brain. The two brains become like two electric clock dials.

Considering the nerve energy due to a ruling thought in B, and the utter inability to resist in a hypnotised subject, such as A has become, it might be expected that A would not only act in accordance with B's thought, but that, so soon as he knew it, A would be in very great hurry to do so, would be very much exhausted after it, and would probably, on returning to himself, be quite forgetful of it.

Before bringing my remarks to a close I may refer to the thousands of experiments in thought reading, or, rather, brain reading, which are now from time to time occurring in private drawing-rooms throughout the country. Most of these experiments have been attended with partial success. Indeed, considering the very rough and deficient way in which these extremely delicate experiments have been conducted, the amount of success I have myself witnessed I regard as surprising. The nerve counterpart in the brain, the foundation of the whole process, can hardly have been sharply defined. A very slight approach to the sensitiveness of the hypnotic state is all that can be attained by being blindfolded, though the thought reader is undoubtedly much indebted to the assiduity of gentlemen anxious to secure the complete bandaging of the eyes,—a zeal at which Mr. Bishop must often have smiled. Nevertheless the guesses of the most unprofessional thought readers have led again and again to the often-repeated expression "There must be something in it."

The foregoing remarks have no claim to be regarded as demonstrative, or anything more than hypothetical and suggestive. The physiologist will point out in them assumptions unproved, and perhaps incapable of proof. The materialist will assert that my "brain counterpart" of thought *is* thought, and will assure me that to speak of thought as anything beyond molecular action is extremely dangerous, mischievous, and ignorant.

One thing let me earnestly disclaim. I have no pretension to dissipate the mystery in thought reading. Only its real mystery is not superficial, a mere nine days' wonder, but a part of the profound mystery of life,—a mystery for Science, as the ages run, deeply and more deeply to explore, but not to fathom. It is *because it is natural* that it is admirable and wonderful, and that we may have a reasonable hope that, in time to come, it may prove to be of great value in the benevolent and Christian science of Mental Therapeutics.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 288.)

BEFORE continuing further our examination of the system of science teaching that has to be adopted in the Elementary Science Schools and Classes under the Department of Science and Art, and the examination and payment on result systems in operation, we will briefly explain what we mean by the terms—*information*, *knowledge*, and *science*, as much confusion of thought prevails amongst the public in general, with respect to the meaning of these and other terms which have to be employed in discussing education questions.

The accumulation of stray particulars by means of the memory we term information; in every stage of life we are constantly acquiring information; but it is the predominating mental process that is in operation in childhood, and amongst the uncivilised and uneducated.

When *information* has been appropriated by us and thoroughly matured; in other words, when it has become a part of our own intelligence, or, to use Mr. Herbert Spencer's expression, when it has been turned into *faculty*; when, in short, we can reason about it and make use of it, we designate it knowledge.

Every human being, the uneducated, as well as the educated, reasons; but the uneducated reasons only about particulars, from like to like; he cannot, like the educated, discover that what is true of one thing is equally true of many other things; he is not, in fact, able, except in very simple cases, to generalise,—that is, draw a general law from particular cases; and it is by generalisation that the laws of *Nature* are learned from observation and experiment. Every human being before the time of Newton had observed that heavy bodies fall to the earth; but that great Philosopher reasoned on the fact, and the result of his reasoning led him to discover the Law of Gravity, and that this law governs, not alone Mundane matter, but that of other worlds. "General reasonings," states Hume, "seem intricate merely because they are general; nor is it easy for the bulk of mankind to distinguish, in a great number of particulars, that common circumstance in which they all agree, or to extract it pure and unmixed from other superfluous circumstances. Every judgment or conclusion with them is particular. They cannot enlarge their view to those universal propositions which comprehend under them an infinite number of individuals, and include a whole science in a single theorem. Their eye is confounded with such an extensive prospect; and the conclusions derived from it, even though clearly expressed, seem intricate and obscure."

The kind of education that prevails in most of our schools and colleges consists in crowding into the minds of the learners, unconnected—and therefore unprolific—facts and particulars. Education, too, generally begins and ends here in this land of educational endowments; for anyone can become or be appointed a teacher; seldom has he to produce the requisite credentials that he has even *exact* knowledge of the subject he has to teach, and he is never required to prove that he has the power or faculty for training the mind; and yet it is only those who have that faculty who can rightly train and educate each individual mind so that the reasoning-power is expanded by causing the information acquired to be converted into knowledge.

When knowledge extends to a methodical comprehension of general laws and principles, it is called *science*; this is the highest stage of mental development, and many minds are unable to reach it; the many being apparently incapable of being cultured beyond a particular point. This is especially the case with the inferior human races. Mr. Herbert Spencer has in his first volume ("The Principles of Psychology") collected together a series of most interesting examples on this most important and interesting subject.

From what has been stated it will be apparent to all that the method the teacher adopts for imparting information is of the highest importance, more important for training and expanding the mind of the learner than the kind of information conveyed. If the wrong method is adopted—wrong because it does not correspond with the order of the unfolding of the mental faculties—the mind of the taught revolts; but if the right method is adopted, the taught—especially the young—delight in acquiring knowledge. One fundamental principle in all sound teaching is to commence with some particular the learner knows or can readily comprehend, and so ascend, from the simple to the complex, by a series of easy and natural gradations, to what at the commencement the learner did not know; so that he becomes, as it were, his own instructor, as he discovers apparently of himself the knowledge conveyed. This is the reason why children delight in picking up information themselves, but are *stupid*, *drowsy*, and *sulky*, in school, if the mechanical routine system of teaching prevails. The late Dr. John Brown in the article "Education through the Senses," in his work "Horæ Subsecivæ," humorously describes the difference in feeling children exhibit in acquiring information themselves, with that which they exhibit in a school where the mind is tortured by the system of teaching adopted. The superiority of Pestalozzi's system and Frobel's Kindergarten method of education over all other systems for teaching children is due in my opinion to the fact that they have systematised the method children themselves adopt in acquiring information. In the Platonic dialogue where

Socrates undertakes to show his friend that his boy servant or slave knew Geometry, Socrates commences with the figure of a square which the boy knew, and he proceeds in such a natural order that the boy discovered, by his own unaided efforts, as it were, what he had not known before.

The change the learner displays for acquiring knowledge is marvellous, if a rational method of teaching a subject—a method in accordance with the laws of mental development—is substituted for a mechanical routine system; the apathy and disgust for learning he had before shown is replaced by the greatest earnestness and delight. I have been a witness of many cases of the kind; but the one which most impressed me I will briefly relate:—Many years ago I accepted the post of teacher of Chemistry at Queenwood College, Hampshire; the College at that time comprised a boys' school and an Agricultural College; the Agricultural pupils were all young men; most of the boys as well as the young men were instructed in chemical analysis in the laboratory attached to the Institution. When I entered upon my duties, I found the book in use was the "Giessen Outlines," and, to my surprise and discouragement, both the young men and boys exhibited a thorough disgust for Chemistry as a study: the young men would not, with the exception of one or two, attend the classes on this subject, and the boys only attended their's under compulsion. Most of them could analyse *complicated* mixtures pretty accurately; but they did not know why and the wherefore; they simply made the analyses as directed by the tables in the book. They explained to me why they disliked the subject; they said, "we can make the analyses, but we do not understand what we are doing, and therefore we do not like the study." After much thought upon the matter, I drew up some analytical tables myself, which I afterwards published, which overcame all the difficulties, and turned a study which had hitherto caused disgust into a great source of pleasure to *both* classes of students: not one of them would be willingly absent from class after the change in the method of teaching the subject had been made. The tables were framed in accordance with the laws of mental evolution; they are so constructed that the learner has to exercise the faculty of judgment or comparison (perception of difference or agreement), which philosophers of all schools agree in placing amongst the original powers of the human being. The system compels the pupil himself to *Compare*, *Distinguish*, *Judge*; he therefore becomes an intelligent and active *Discoverer*, for he discovers, himself, the methods for separating and detecting the different members in each group of substances, and so throughout the entire analytical course. But my plan possesses other important advantages over every other which has yet been proposed. It exhibits a like progression to the mind; it begins with a few subjects, and successively adds to them until the entire analytical course is reached; it proceeds, in short, from the simple to the complex.

Those who seek to reform and improve any established system like the one under discussion have generally to deal with two classes of *obstructives:* the more formidable class consists of those who are pecuniarily interested in preventing any change; the other class consists of those who are only superficially acquainted with the subject: those composing the latter class generally cite authority in support of their views, and they are not unfrequently made use of under this veil of authority by the former class in opposing all real reform. Now as written examinations form the chief, if not the sole, tests for estimating the students' attainments in the Inductive Sciences at our different Universities, these apparently high authorities in *all* educational matters may be adduced in opposition to my views of the subject: it may be well therefore to inform the second class of opponents that only such branches of study were examined upon whose written examinations were first established at our Universities. As the examinee could do or put in practice at the examination just as he would in any future employment in the actual business of life, what were termed mere *information* subjects—which do not, like the former, admit of *direct measurement*—were excluded, and it was long before they were admitted as examination subjects. Pen, ink, and paper are the instruments, in addition to books, which students of languages and the Deductive Sciences require for the prosecution of their studies in these subjects; but pen, ink, and paper, as well as books, are only subsidiary instruments in the cultivation of the Inductive Sciences: to acquire a knowledge of these sciences the student must not only know what has been done by others, but he must himself study the productions and operations of Nature in the laboratory or in the field; and it is there only he can be efficiently examined, for it is there only that it can be ascertained whether he has acquired a knowledge of things or only the names of things. This examination system, even at our Universities, is destructive of good teaching; the Professor is apt to depend more for obtaining a class by getting his subject to be one examined upon than attracting them by good teaching, and the students, I was informed some years ago by a Professor of Chemistry at one of the Colleges at Cambridge, will only learn what will pass them; they cannot be induced to stray beyond the limits of probable questions; the training they receive, according to the Rector of Lincoln College, Oxford, is not training in investigation, in research, in scientific procedure, *but in the art of producing a clever answer to a question on a subject of which they have no real knowledge.*

Written examinations, however perfectly the questions may be framed, cannot be made efficient and practical tests for any of the Inductive Sciences, whether experimental or observational; but, as long as they are employed as tests, the questions given ought chiefly to be of the kind that would test as completely as possible whether the examinee had acquired a *knowledge* of his subject or whether what he had acquired was mere information. *Knowledge questions,** as I will term them, are rarely given in examination papers on Chemistry; the questions generally relate to particular facts, and are therefore mere information questions; and it is this class of questions that are chiefly given at the Department's examinations. Indeed the practical difficulties of awarding marks *equally* and fairly to such a large number of students, if questions were given which would test as efficiently as possible whether the examinees had been trained in learning the science, to reason, and think, themselves, on what they were taught, would be almost impossible; because many of the questions would only be answered in part by the majority. The examiner would, therefore, before he got through all the papers, have become so utterly wearied as to the number of marks he ought to assign to each of the numerous answers to each of the different questions, that his faculty of judgment and comparison would be lost long before he had completed his task. Nor are the difficulties overcome by distributing the papers amongst several examiners. Indeed, another difficulty then arises, for, for questions of this kind, the standard of the different examiners would vary, and, as the teachers are paid on the result system, they would receive unequal payment, on account of the difference in the standards of the examiners. I am afraid, also, if such questions were set, some of the assistant examiners, who are paid so much per dozen papers they examine, would perform their task in a more perfunctory manner than they are considered to do at present; for it has been observed that it is not always in the study of the examiner that these papers are looked over and the marks assigned, but that they are sometimes examined in such unsuitable places as Railway Carriages, Examination Rooms, &c. I am afraid the poor science teachers sometimes suffer pecuniarily from such slapdash examinations, conducted at odd times, of their pupils' papers.

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* I have given examples of what I term Knowledge Questions in my work "Education, Scientific and Technical," in the chapter on Examinations and Examiners.

I will give an example to show how differently two examiners will examine and mark, even in a comparatively small chemical class; and therefore it shows how uncertain it must be as to what science teachers who are paid on the result system will earn, as it must vary with the examiner who happens to examine the pupils' papers; and it shows, further, that confusion and discrepancies would still more prevail if knowledge questions were largely employed. And it clearly shows that on account of the uncertainty of the amount of payment to be received, it will prevent some of the most competent from becoming teachers under this system.

The two examiners I will distinguish by the letters A and B; A is one of the professional examiners, and B I believe is one of the assistant examiners. The class examined was not one in the elementary science schools, but in a college of science. Examiner A does not belong to the college, but is appointed by the authorities to set a paper and examine the answers given; B is the teacher in the college—he also sets a paper and examines the answers to that paper. The examination of which I give the results was held about eighteen months ago, but a more recent examination by the same parties in the same college would show similar discrepancies in the marks assigned by the two examiners.

It is perfectly evident from the discrepancies in the marks assigned to most of the students, that, either examiner A thought the students ought to have had a better acquaintance with the subject than the results of his examination proved they had, or the two examiners adopted a very different system of marking, as B in not one single instance marked below A, but in every case above him. The teacher did not lose any payment by the discrepancies, as he is not paid on the result system; but it would have made a material difference to one paid on the result system whether A or B's marks were adopted; for A's marks amount on the average to 40·5, whilst the average of B's marks amount to 69·6; or for every 100 marks given by A 171·85 were given by B.

I give numbers in place of the names of the students :—

	A's Marks.	B's Marks.
	Total Number of Marks 100.	
1.	92·5	96
2.	71·7	94
3.	71·1	86
4.	64·7	97
5.	64·7	90
6.	61·0	88
7.	57·7	89
8.	50·3	89
9.	43·8	75
10.	36·9	50
11.	35·8	65
12.	34·8	63
13.	34·2	91
14.	32·1	83
15.	25·7	71
16.	23·5	30
17.	23·0	47
18.	18·7	71
19.	15·5	49
20.	13·9	59
21.	12·3	30
22.	8·0	18

(To be continued.)

ANALYSES OF BOOKS.

Physiological Cruelty or Fact v. *Fancy: An Enquiry into the Vivisection Question.* By PHILANTHROPOS. London: Tinsley Brothers.

SECOND NOTICE (see p. 354).

PHILANTHROPOS says, in meeting Mr. Hutton's contention, " We must try, then, to imagine ourselves belonging to superior beings who make us obey them in all things, and whose reasons we can seldom understand. They tie us up in order to prevent our going where they wish—they prevent our making love, for fear of its interfering with our work—they keep us in prisons, because they like to look at us and to hear us sing—they take away our clothes, in order to wear them themselves—they crop our ears, because they think we look prettier with them short—they do various painful things to us in order to make us taste nicer when cooked—and, finally, they kill and eat us. . . . If we were suddenly enabled to understand the reasons for each action, our dispositions remaining the same, is it likely that the sense of injury which had not been evoked by anything else would arise when they went on to use us for experiments for the advancement of their science and the improvement of their own health ? "

In the next chapter the author puts the much-needed question " What is vivisection ? " On this subject the vaguest notions prevail, not merely among the public, but among Bestiarian advocates, who, if better informed themselves, have no objection to profit by vulgar confusion and exaggeration. Philanthropos shows how little—vanishingly little—of the work performed in a physiological laboratory can in any manner be included under this name. He shows that " in England animals are never dissected alive in order to show the relations of their parts. . . . There is no room for talking about medical students being demoralised by witnessing tortures : there are none for them to witness." Painful operations are confined to purposes of original research, and " in the few cases where pain must be given it is generally very slight." The author enumerates inoculations, used in studying the origin and communication of disease, experiments on the effects of drugs, and especially the treatment of poisons ; and, lastly, a few experiments relating to various animal functions. In this latter class anæsthetics were used, wherever possible, before any law was passed on the subject. Here Philanthropos truly says—" Yet although no fact is better authenticated than this systematic narcotising of creatures experimented on, it is quietly and constantly ignored; vivisection is described (by Miss Cobbe) as the 'worst form of cruelty we know,' and the words 'agony,' 'torture,' and 'torment' are scattered about as if no such things existed as chloroform, ether, and morphia." The number of experiments in which pain—not even apparently great—was produced during the years 1878, 1879, and 1880, amounted, according to the official report, to less than 100! Truly a drop in the bucket compared with the sufferings of animals in other causes than the pursuit of knowledge!

In the sixth chapter the author explains the necessity of experiment to physiology. From this chapter, which we strongly recommend to the careful study of our non-medical—or, more widely speaking, non-biological—readers, we can merely quote the following pregnant passage:—"Those who defend physiological experiment as an absolute necessity to medicine do so—not because this or that drug has been discovered by its means, this or that operation perfected through its practice. They defend it, because without it medicine is based upon ignorance, and every doctor is a charlatan patching at a wonderful mechanism of which he knows nothing. They defend it, because it is the foundation upon which physiology as a science stands. The pseudo-sciences rest upon theorising, guess-work, and empiricism; a true science rests upon experiment. If physiology be deprived of this necessary foundation it will be degraded through no fault of its disciples; it will not fall to pieces, because that which has been won cannot be taken away, but it will be unable to encroach any further upon the morass of human ignorance, because forbidden to lay a firm footing for its advancing tread. But, after all, interests differ. There are some who do not care for that morass to be invaded. 'Quand on veut dessêcher un marais, on ne fait pas voter les grenouilles.'" In England, unfortunately, we allow the frogs to vote, and they croak loudly enough, in Parliament, in public meetings, and in the pages of certain of our contemporaries.

In the last chapter of his book the author discusses the legislation on the subject—past, present, and possible. Concerning such legislation he writes:—"It is very curious and interesting, and has the great merit of being peculiarly British. That is to say, it is not trammelled by any principle previously laid down or hindered by any consideration of reasoning or consistency. To found a new law upon a distinct principle, from which its enactments develop logically, has a Continental flavour about it displeasing to the national mind, and reminds us in some way of centralisation.* We prefer to make a fresh regulation every now and then, when somebody makes a fuss and it is necessary to do something." The existing law is well summed up in the following words:—"It is penal to use domestic animals in any way cruelly, but anyone may torture wild creatures in whatever fashion he likes, provided it be not for scientific purposes. Nothing makes it criminal to give pain to a wild animal *except* having sufficient justification."

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* In one sphere at least we submit humbly enough to the sway of a centralising bureaucracy.

We find next a very clear and fair history of the rise and progress of the Bestiarian agitation. We find especial mention of the fact that, in spite of the aid of Detectives, the Society for the Prevention of Cruelty to Animals was utterly unable to find anything to warrant legal proceedings against a physiological experimentalist up to the abortive Norwich proceedings. Funds were there in abundance; there was espionage, vigour, and a hostile animus, but there was nothing to detect!

We come now to the Royal Commission of Inquiry appointed in June, 1875. To this step the medical profession and the scientific world generally offered no objection. The composition of the Commission was somewhat curious. It comprised three politicians (Viscount Cardwell, Baron Winmarleigh, and the Right Hon. W. E. Forster), a lawyer (Sir J. B. Karslake), two men of Science (Prof. Huxley and Mr. Erichsen), and a journalist (Mr. Hutton, of the "Spectator"). On what principle the last-named gentleman was selected in preference to any other of the thirty and odd millions of inhabitants of the United Kingdom we are not aware. He seems to have, throughout the inquiry, played the part of examining counsel for the Bestiarians. But though he signed the Report of the Commission in which the necessity of physiological experimentation is admitted, he has found it not contrary to his notions of consistency to persist in the agitation. Mr. Jesse, we understand, goes the length of accusing the Commissioners of suppressing evidence brought before them, which is certainly an ungrateful return for Mr. Hutton's advocacy. It has been truthfully said that in this celebrated inquiry the evidence went beyond the facts, the report beyond the evidence, and the subsequent legislation beyond the report. The Right Hon. Robert Lowe (now Lord Sherbrooke) pronounced the proceeding of the Commissioners "very singular. They acquitted the accused, and sentenced them to be under the surveillance of the police for life." It is hinted in certain quarters that both the appointment of the Commission and the legislation which followed are at least indirectly due to the influence of a most exalted Personage. If so we would, with all deference, suggest that her dislike to cruelty might have been more fittingly displayed in the suppression of the Royal buckhounds and their performances.

The heads of the "Anti-Vivisection Act" of 1876 are here given. It is shown, as an objectionable feature, and as a departure from the Recommendations of the Commission, that the Home Secretary is in practice invested with the arbitrary and irresponsible power of deciding whether, and under what conditions, certificates and licenses under the Act are to be granted. In consequence the "Medical Dictator has prevented researches into antidotes to snake-poisons, the multiplication of septic organisms, the physiology of the brain, the functions of the spleen, the method of renal secretion, aseptic dressing of wounds, the actions of certain poisons, intestinal secretions and movements, ligatures on arteries, and other matters. Men are left to die of poison, wounds, and disease, for want of the knowledge that can only be obtained at the expense of animals. . . . Dr. Brunton has been forbidden to seek for antidotes to snake-bites, Professor Fraser has been checked in his attempts to study the nature of the poison used by the natives of Borneo upon their arrows, while Prof. Lister has had to leave England in order to carry on his researches. And besides the list of stifled investigations already given, how many more are left unattempted because of the difficulties thrown in the way? Surely this state of things is not creditable, and ought not to endure." The author, as we have already intimated, takes an exceedingly moderate ground. He does not, like ourselves, demand the repeal of the Act of 1876, but would be content with its administration in a spirit less unfavourable to Science than has hitherto prevailed. He merely wishes the Home Secretary to be guided by the "competent advisers" whom the Act provides.

We hope that this work will receive the wide and careful study which it merits, and that its accurate truth and sound reasoning may prove an antidote to the sophistical and fanatic eloquence of Bestiarian speakers and writers.

The Natural Genesis. By GERALD MASSEY. Vol. I.

WE have here the first volume of a bulky work, the importance of which is fully proportionate to its extent. Our readers will perceive that we give no publisher's name. Our excuse must be that none is given in the copy which has been forwarded to us. We can merely give the address of the printers: R. Clay, Sons, and Taylor, Bread Street Hill, Queen Victoria Street, E.C.

But what is the subject of the book? Mr. Massey is an independent thinker, a heretic. After prolonged and laborious enquiry he rejects certain modern theories as to the origin of civilisation and the formation of language. He is no believer in the "Aryan hypothesis." He contends that the transition from the bestial to the lowest human condition took place not in Central Asia or Northern India, but in the interior of Africa, and that the stream of culture flowed along the Valley of the Nile. He shows that language is derived not from abstract roots, but from signs and symbolic actions far antecedent. He does away with the notions of a civilisation springing up suddenly or miraculously communicated to man, and of a language rich and complete in its very origin. For the first time, perhaps, we have inquires into primitive philology, mythology, and the early history of our species untainted by the preconceived notion of an absolute and qualitative distinction between man and the lower animals. The author's results are in strict accord with those which modern naturalists have reached by totally different processes. We do not hesitate to say that if the substance of this work could be presented in a condensed form, freed as much as possible from "scaffolding," it would form a valuable—almost necessary—companion to Darwin's "Descent of Man," the one work complementing and supporting the other.

We must, however, remark that much remains to be done before Mr. Massey's labours can be presented in such a form. At present there is neither title-page, index, table of contents, preface, nor introductory chapter. Only the leisurely and conscientious reader, or the candid reviewer, will succeed in fairly grasping Mr. Massey's current of thought; this the rather because the conclusions reached will be, to many, grievously unwelcome.

We find here successively discussed the natural genesis of the Kamite typology, the typology of primitive customs, the typology of the two truths, the typology of numbers, the typology of primordial onomatopœia and aboriginal African sounds, the typology of the mythical serpent or dragon, the typology of the mythical mount, the tree, the cross, and the four corners, and the typology of the mythical great mother, the two sisters, the twins, the triads, trinity, and tetrad.

As a specimen of the author's method of conducting this great inquiry we make certain extracts from the chapter on the typology of onomatopœia. Mr. Massey writes :—"The Aryanists have laboured to set the great pyramid of language on its apex in Asia instead of on its base in Africa, where we have now to seek for the veriest beginnings. My appeal is made to anthropologists, ethnologists, and evolutionists, not to mere philologists limited to the Aryan area, who, as non-evolutionists, have laid fast hold at the wrong end of things.

"The Inner African languages prove that words had earlier forms than those which have become the 'roots' of the Aryanists. Max Müller has said that in the Sanskrit word *Asu*, which denotes the vital breath, the original meaning of the root '*As*' has been preserved." He writes :—"*As*, in order to give rise to such a noun as *asu*, must have meant to breathe ; then to live ; then to exist ; and it must have passed through all these stages before it could have been used as the abstract auxiliary verb which we find not only in Sanskrit, but in all the Aryan languages. Unless this one derivative, *Asu*, life, had been preserved in Sanskrit, it would have been impossible to guess the original material meaning of the root *As*, to be." Mr. Massey replies:—"The African languages show that *asu*, to breathe, is *not a primary of speech;* no vowel is *primary in the earliest formation of words.* In Egyptian *ses* is to breathe, and in Africa beyond: *zuzu* has the same meaning in the Nupe, Esitako, Gugu Basa tongues; *zuezui* in the Param, *yisie* in the Kupa, and *zo* in the Ebe."

He continues—"It has been asked how did *Da* (Sanskrit) come to mean giving? Professor Noiré holds that primitive man said *accidentally Da.* And here we have a 'root' of language! But *da* is only a worn-down form of word found in Sanskrit. It is the Egyptian *Tâ*, to give and take, and also a gift. The full hierogylyphic word is *Tat*, and it belongs to the stage of mere duplicated words and gesture-signs. It is written as the hand, which is the Tat ideograph; English *daddle* for the fist, *ntata* for the hand in the Meto and Matatan, and *tata* in the Igu tongue. Long before the abstract idea of giving was conveyed by *da* or *tâ*, the *tat* was *presented* in gesture-language with the offering, or in the act of offering. . . . Language certainly did not originate with the 'roots' of the Aryanists, which are the worn-down forms of earlier words. It did not begin with 'abstract roots,' nor with dictionary words at all, but with things, objects, gesture-signs, and involuntary sounds." We may here remark that the very term "root" conveys an analogy fatal to its advocates. The plant does not originate with the root, but with the seed, and puts out the root subsequently.

Elsewhere, as a further explanation of his meaning, the author says:—"That which we can *talk*, *say*, and *write* was first *enacted*, and the most primitive customs were the sole *records* of such acting by men who *performed* those things that could not otherwise have been memorised. These customs had their origin in gesture-language; they constitute the drama of dumb humanity, and volumes might be filled in showing the (to us) unnatural-looking results of an origin that was quite natural."

The following passage refers to a recent blunder into which philologists tumbled blindly:—"Comparative philology, working with words in their later phase, divorced from *things* is responsible for the false inference that until recent times, later than those of the Veda, the Avesta, the Hebrew, and Homeric writings, men were deficient in the perception of colour; that there was, in fact, a condition of Miopœia answering to their insanity of Mythopœia. Geiger has even affirmed that the language-maker must have been blue-blind. Max Müller has affirmed that the blue heaven does not appear in the Vedas, the Avesta, or the Old Testament. It is true that language did not commence by naming those mere appearances of things in which the comparative mythologists take such inordinate delight. Many early languages have no word for blue as a colour, and yet blue as a thing may be found in them." Thus the Egyptian name for blue is *khesbet*, *i.e.*, lazulite. It may in one sense be considered a digression, but we cannot help pointing out the utterly fallacious character of the inference that because a certain race of men had no distinct, definite word for a colour, they were therefore incapable of distinguishing such colour. We find that insects recognise and remember colours. Are we to suppose that they have, therefore, a nomenclature for colours ? We highly specialised men of civilised Europe and America can distinguish and carry in our memory hundreds of odours, pleasant or offensive. Yet our names for them are few indeed, and so vague and indefinite, that we once heard a man speak of a "heavy sweet smell, like dung." He was not joking. It is much the same with flavours. Here, also, Mr. Massey very justly says—"Power of perceiving qualities and distinguishing things does not depend on the possession of words to express shades of difference. Sweet could be distinguished from bitter when the one was only expressed by the mouth watering and a smack of gustativeness ; the other by spitting, with the accompaniment of an interjection of repugnance. . . . The early men thought in things and images where we think in words, or think we think." Leibnitz said that the writing of the Chinese might seem to have been invented by a deaf person, its formation being so near to that of gesture-signs addressed to the eye. The oldest Chinese characters, two hundred in number, are called *Siang-Hing*,—that is, images or ideographic representations. Elsewhere the author remarks—"Verbs would be first *enacted* before they were uttered in what we could recognise as speech. A pair of feet Going is the sign of the verb to Go, and Going pourtrayed in several forms preceded any abstract verb for to Go."

Turning reluctantly from the section on the typology of language, which must ultimately give comparative philology a new departure and a more rational character, we briefly glance at the author's labours in other, though kindred, directions. In his exposition of the genesis of the Kamite typology, Mr. Massey says that the unwritten, esoteric teaching of the Gnosis, the Kabalah, the inner mysteries, was concealed, not on account of its profundity, but because of its primitiveness. "It is not the ancient legends that lie ; the creators of these did not deal falsely with us. The falsehood is solely the result of ignorantly mistaking mythology for revelation and historical truth. They did not teach geology in the ancient mysteries. The Christian world assumed that they did, and therefore it was found in opposition to scientific geology."

The following passage is very significant :—"The religious ritual of the moderns is crowded like a kitchen-midden with the refuse relics of customs that were once natural, and are now clung to as if they were supernatural in their efficacy, because their origin is unknown. Such customs are like those rudimentary organs of animals which Nature has suppressed and superseded, and which only tell of uses long since passed away."

Commenting on the custom of salutation by rubbing noses together, as common among not a few savage tribes, Mr. Massey reminds us that it "goes back to the animal mode of salutation by smelling." In this direction he has done good service in connecting the language and customs of animals with those of man.

Reluctantly breaking off our survey of this remarkable book, we can merely hope that what we have said may at least excite the curiosity of the reader, and lead him to inquire for himself. We would, indeed, bespeak for Mr. Massey's work the earnest attention of Evolutionists. To us it seems that he is turning the only position of importance still held by our opponents, and that his movement, if properly followed up, will be decisive.

A Manual of Photographic Chemistry, Theoretical and Practical. By Rev. T. FREDERICK HARDWICK, M.A. Edited by J. TRAILL TAYLOR, Editor of the Photographic Times and American Photographer. London: J. and A. Churchill.

THIS work, having already reached its ninth edition, may be considered as having established itself in public favour. The present editor tells us that, since the appearance of former editions, two changes of importance have occurred. One of these appears to be the last revolution in chemical nomenclature; the other, of a practical nature, is the introduction of a gelatine emulsion in place of collodion. He accordingly uses in the work an approximation to the modern nomenclature, though remarking that it does not seem judicious entirely to discard the old. This caution is justified by the fact that manufacturers, drysalters, and persons practically engaged in the various chemical arts, still employ almost exclusively the language current in the second quarter of the present century. Perhaps, however, his best plan would have been to have placed the old names in brackets after the new ones, or inversely.

A few errors appear to have escaped the notice both of author and editor. Thus, under "Alum," we find the statement that "much of the common alum contains ammonia as well as potassium." There was at one time a great abundance of so-called ammonia-alum in the market in which ammonium took the place of potassium. But we never either heard of or met with a sample in which both these bodies were simultaneously present. Since the discovery of the Stassfurt saline deposits the salts of potash have fallen in price, and are so exclusively used in alum-making that it is now not easy to procure a sample of ammonia alum.

Under "Castor Oil" we read that "this oil is extracted from the seeds of *Ricinus communis* or Palma Christi, both of which are cultivated in warm climates." Palma Christi is simply a synonym for *Ricinus communis*, not a distinct species of tree.

Under "Organic Matter" we find a curious remark:—"This term is often employed to designate varieties of non-volatile vegetable and animal substances of unknown composition, which are prone to change by absorption of oxygen. Bodies which have a definite formula, however, are often included in the class of organic matters if they readily pass by oxidation into ill-defined products. But a stable vegetable acid like acetic acid, or a neutral substance not readily oxidisable, such as glycerine, although really organic in composition, would not usually be referred to by this term." We certainly have never heard the term "organic matter" applied exclusively or preferentially to unstable bodies or such as are of indefinite or unknown composition. If such a usage exists, the author would have done well to have pointed out its impropriety.

On page 93 we read that "solutions of the sulphocyanides of ammonium or potassium have been recommended for fixing positive photographs instead of hyposulphite of soda; but it is doubtful whether any advantage is gained." But on page 149 it is stated that the sulphocyanides "have the advantage of imparting no sulphur to the print, and they preserve the tones clear and free from mealiness."

As regards the purely photographic or the practical portion of the book before us, there can be no doubt that it fully merits the reputation which it has all along enjoyed. In case of a new edition, which may be looked forward to as a matter of certainty, we should suggest a revision of the earlier or introductory chapters.

Transit Tables for 1883. Giving the Greenwich Mean Time of the Transit of the Sun and of certain Stars, for every Day in the Year; with an Ephemeris of the Sun, Moon, and Planets, and other Information, computed from the Nautical Almanac for Popular Use. By LATIMER CLARK, M.I.C.E., &c. London: A. J. Frost.

THIS work gives instructions in the art of obtaining correct time in any part of the world by means of the transit instrument. The Preface explains the use of this important astronomical instrument, and the method of its adjustment. For this purpose it is merely needful to choose an open site facing southwards, to adjust the level, and point the telescope of the instrument as nearly to the true meridian as can be guessed. The time of passage of any two stars across the centre wire is then noted, selecting from the Tables in the book two which differ decidedly in their altitude. If both pass correctly to the time given in the Tables, the instrument is rightly fixed. If the lower star passes too soon, the transit instrument has been pointed to the east of the true meridian. If, on the contrary, the lower star passes too late, the conclusion is that the instrument is turned to the westward.

When once the adjustment is completed the correct local time may easily be found by noting the stars which pass the meridian and comparing their transit with the time given in the Tables. A correction is then made to find Greenwich time, accordingly as the place of observation lies to the east or west of Greenwich. The difference of longitude is converted into time at the rate of 4 minutes per degree and 4 seconds per minute of longitude. If the place of observation is westward of Greenwich this difference is added to the time given in the tables, but if it is situate eastwards it is subtracted.

The Tables show the transits of the sun, and of five of the principal stars for every day of the current year, and also the transits, altitude, and declination of a number of additional stars.

The second part of the book shows, for each day of the year, the rising and setting of the sun; the rising, transit, and setting of the moon; the sidereal time at mean noon; and the mean temperature at 9 a.m. The opposite page shows the rise, transit, and setting of Mercury, Venus, Mars, Jupiter, and Saturn for six days in each month, and their relative positions to the moon and to different constellations.

The work before us will aid in popularising astronomical observation.

From the Molecular World.[*] Heidelberg: Carl Winter.

THIS remarkable book appears without the name of the author, though to anyone acquainted with the modern chemical literature of Germany the secret of its origin will be exceedingly open. The author represents himself as on a visit to Naples, and as viewing with no small interest the Aquarium, which by the way —unlike certain establishments of the same name nearer home— is a genuine scientific institution, and not a place of assembly for "loose fish." Having inspected the wonders of the watery world he hears of an Aërarium where certain airy—not to say visionary—beings may be viewed. He enters, and looks through the glass sides of the different compartments. In one cell, near the entrance, he sees a tumultuous assemblage of tiny beings which are restlessly darting about in couples. Each of these beings has but one hand, with which it clasps the hand of its companion, and in this manner they move backwards and forwards at the rate of 1844 metres per second; and whilst each pair is thus engaged, each of its constituent members is turning round and round, advancing to or retreating from its partner. In another compartment we see similarly-constituted pairs of one-handed beings, in greenish yellow garb, and smelling not exactly of patchouli. They also belong to the party of progress, though, being much heavier than the last-described sprites, they move only at the rate of 310 metres per second. It is scarcely necessary to tell the names of these beings: the inmates of the first cell are atoms of hydrogen grouped in molecules, whilst the next den is inhabited by chlorine.

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[*] Aus der Molecular-Welt.

In a similar manner, and with a dry humour not to be preserved in any translation, the author figures the molecules of other elements and compounds. Watching a molecule of hydrogen chloride, he asks whether the members of this couple enjoy a permanent inward happiness in their union corresponding to the fire with which it was entered upon? "Of this we cannot feel so certain as might be desired; the couple looks desperately sour, and the humiliated hydrogen seems to think 'affinity, alas affinity, has brought me into a scrape.'"

Our author next discusses the question whether atoms of the same kind within the same molecule may claim equal or unequal rank? Which of these two views is orthodox? No one seems to have permanent authority to decide. Hence many compounds have had more constitutions, and consequently more revolutions, than France. For none of these theories can the author feel any enthusiasm, though he hopes that each may be, perhaps, a nearer approximation to the truth than were its predecessors. "Every, for the time being, modern doctrine in the territory of our science is merciless to former views which it is unable to assimilate, and pronounces them simply injurious.

The following passage is an excellent specimen of the author's line of thought:—"Do you recognise these ladies, each of whom is dancing so gracefully? That is the light Methylia; on her father's side of a good family,—pyrogenita, if not porphyrogenita,—but her mother is a wooden thing. Behind her we see Æthylia, and there is the heavy Amylia. We know them, and a number of their friends of similar character. In our young days they were known only by their fore-names,* and they were recognised as belonging to a certain stamp of radicals. Latterly they have assumed the family name Alkyl, having, I believe, been induced to take this step in Würzburg. What kind of partners have they in this dance? These atom-groups, who evidently take pains to look proud and disagreeable. They are scarcely to be distinguished from each other. If we converse with these conceited beings, we hear each of them say, 'My name is Hydroxyl.' But we have a good memory for chemical features. They are the same who, under their old name Eurhyzen, were so publicly scorned by a French chemist—not appreciated until after his death—that, so to speak, the very dogs would not accept a piece of bread from them. But now, under the new name, they are beings of distinction in the molecular world."

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* The sensible German term for what we absurdly call the "Christian name," though its bearer may be a Jew, a Buddhist, or an Islamite.

The author wages war, as will be seen, against vague, baseless hypotheses, against "paper-science," and insists upon a firm foundation of facts. Hence his satire is not out of place in an age when undemonstrated and undemonstrable assumptions readily pave the way to a certain kind of reputation. All chemists,—and men of Science in general,—if sufficiently versed in the German language, will find this work suggestive.

The treatise is printed not in the German type, but in an unpleasant modification of the Latin character. Lest the reader should proceed with too great comfort, the long *s*, which has disappeared from use in England and France, is employed, except at the end of a word. For the compound letter *sz*, which many German printers discard in favour of *ss*, there has been invented a new letter, resembling a Greek *β*, which, like the fox in the fable, has lost his tail in a trap.

Notes on the Detection of the Acids usually met with in Analysis. By J. William James, Ph.D., F.C.S. London: J. and A. Churchill.

The author of this little Manual remarks, in his Preface, that though there are numbers of books on qualitative analysis in which the detection of the bases is ably explained, yet the acids have been relatively overlooked, at least as far as regards their detection when occurring in mixture. This deficiency it is his object to make good. The instructions given are clear and simple, and will doubtless prove useful to laboratory students.

Longman's Magazine. May, 1883.

In this issue we notice a pleasantly-written article entitled "An American's Impressions of some British Song-Birds." The writer, Mr. John Burroughs, is an able and enthusiastic observer of bird-life, and puts on record some points which our British ornithologists seem to have overlooked. He is particularly struck with the abundance and the eager vociferation of the chaffinch, or, as it is locally called, shilfa, flax-finch, flacky, or spink. He says "the most abundant song-bird in Britain is the chaffinch, the most conspicuous wild flower (in June at least) is the foxglove, and the most ubiquitous weed is the nettle." The first of these three assertions I fully admit; but as to the foxglove we could show Mr. Burroughs districts where it is entirely wanting.

The author writes :—"I could well understand, after being in England for a few days, why to English travellers our songsters seem inferior to their own. They are much less loud and vociferous, less abundant and familiar; one needs to woo them more; they are less recently out of the wilderness; their songs have the delicacy and wildness of most woodsey forms, and are as plaintive as the whistle of the wind. They are not so happy a race as the English songsters, as if life had more trials for them, as doubtless it has in their enforced migrations and in the severer climate with which they have to contend."

The comparative happiness of birds on either side of the Atlantic is a difficult question; but what with nest-robbing urchins, with bird-catchers, and town sportsmen,—three classes ever to be anathematised by the ornithologist,—our British songsters have but a hard life.

The following is a curious and interesting remark :—"I was soon struck with the fact that in the main the British song-birds lead up to and culminate in two species—namely, in the lark and the nightingale. In these two birds all that is characteristic in the other songsters is gathered up and carried to perfection. They crown the series. Nearly all the finches and pipits seem like rude studies and sketches of the sky-lark, and nearly all the warblers and thrushes point to the nightingale; their powers have fully blossomed in her. There is nothing in the lark's song, in the quality or in the manner of it, that is not sketched or suggested in some voice lower in the choir, and the tone and compass of the warblers mount in regular gradation from the clinking note of the chiffchaff up to the nightingale."

Mr. Burroughs gives a favourable estimate of the blackbird, the willow-warbler, the wren, and the robin. The wood-lark he sought in vain, and we have taken good care that he should not hear the golden oriole, which once was ours.

On hearing the European cuckoo he regrets that he had ever heard a cuckoo-clock. These devices, extremely rare in England, must be very common in America, since they cause the note of the bird to have "a second-hand, artificial sound."

Reading over this paper we are struck with an instance of the feebleness of the so-called Anglo-Saxon race in name-giving. There are in America birds, not a few, bearing the same popular names as certain European species, but totally distinct. Thus the American robin is a kind of thrush. They have a sparrow distinct from ours, though, unfortunately for themselves and their avi-fauna, they have imported the latter bird. They have also a goldfinch and a cuckoo of their own. This identity of names leads to confusion, and will never be rectified.

Report on Insects for the Year 1881. By J. HENRY COMSTOCK, Professor of Entomology in Cornell University. Washington: Government Printing-Office.

IT may perhaps strike some of our readers as singular that so shrewd and practical a people as the Americans should have endowed chairs of Entomology in their Universities, and have appointed official entomologists in not a few of the States. Such a course of action will doubtless seem strange to men of mere literary culture, to the Popes of days by-gone no less than to the Ruskins of the present,—men who will not or cannot observe what overwhelming results spring from the continuous or ubiquitous action of agents individually trifling and feeble. The importance, or rather the necessity, of attending to the cumulative action of small things is one of the most precious of the lessons taught by our great Darwin, as well in his life as in his works.

Shrewd and practical? Precisely; and it is in virtue of that very shrewdness and practicality that the Americans have learnt the prodigious power of insects for good as for evil, and the interest which consequently attaches to their study. We, too, suffer at times heavily—both in the home kingdoms and still more in the Colonies—from insect depredators. But we are slow in understanding the lessons of such facts, and certain of our ethicists and æstheticists—blinder even than the utilitarians of the old school—still look upon Entomology as a frivolous pursuit.

In the Report before us Prof. Comstock describes certain insects, both harmful and beneficial, so that the public may know what to kill by every means in their power, and, on the other hand, what to spare and to protect.

The first species mentioned is the apple-maggot (*Trypœta promonella*), a two-winged insect which in the larval condition bores into the pulp of the apple, which is often honeycombed so as to be rendered perfectly useless. When mature it is a black and white fly, with banded wings. It originally fed upon certain species of hawthorn and upon crab-apples, but, by one of those changes of habit which we occasionally observe in insects, it has lately, in New York and the New England States, turned its attention to the cultivated apple. It attacks by preference the early species, and in some quarters has already rendered their cultivation unremunerative,

Two other noxious species are the "Pomace flies" (*Drosophila ampelophila* and *D. amœna*). These also belong to the order of two-winged flies, and, from having originally fed upon the decaying fruit found scattered on the ground in orchards, they have taken to haunt cider-mills, and vats in which grapes are fermenting. Here they have become quite a nuisance. Worse still, if a bird has made a hole in a grape these flies deposit their eggs in the pulp, and the larvæ bore from grape to grape till the whole cluster consists of nothing but empty skins.

All these insects are described at length, and figured for more easy recognition. We regret, however, to find that the distinguished author makes use of the neologisms of Prof. Wilder. Thus we read that, in the pupa of *D. amœna*, "the cephalic spiracles project directly *cephalad*." Such language, in a treatise which is intended not merely for scientific biologists, but for farmers and gardeners, seems to us not over-judicious.

Several of the ladybirds (Coccinellidæ) are described and figured, not by any means as enemies, but as valuable allies, which prey upon Aphides, scale-insects, &c., and therefore require to be known and preserved. A knowledge of their appearance and habits is now the more necessary, since by ignorant and careless observers they may be confounded with the Chrysomelidæ, to which group the dreaded Colorado beetle belongs. We have known an instance of a gardener who, till informed of his error, systematically destroyed the ladybirds, under the impression that they were either Colorado beetles or might turn into such.

As regards the methods used for the destruction of scale-insects, "doctors differ." Prof. C. V. Riley, the Entomologist to the Department of Agriculture, in a paragraph which has somehow been inserted in this work without the knowledge and consent of Prof. Comstock, recommends an emulsion of kerosene as the best agent, and as having been very satisfactorily used by the orange-growers in Florida. Prof. Comstock, on the other hand, recommends a solution of 1 lb. "concentrated lye" in 1 gallon of water, to be applied to the tree in winter, and to be supplemented if needful in the summer by a wash of $\frac{1}{4}$ lb. whale-oil soap in a gallon of water in which some sulphur has been boiled up. The "concentrated lye" in question is an impure alkali, containing 8·3 parts caustic potash to 91·7 parts caustic soda.

Mention is also made of two American lac-insects (*Carteria larreæ* and *C. mexicana*), which secrete a matter supposed identical with the lac of India produced by *C. lacca*.

A new wax-producing insect, *Cerococcus quercus*, is also described.

The Mason College Magazine. Vol. I., No. 5, May, 1883.
Birmingham: Cornish Bros.

On taking up this little magazine we expected to find something thought-provoking, and we were not disappointed. "Overtaking the Rays of Light," by M. J. H. Poynting, Professor of Physics, is a most remarkable paper, calculated to inspire even the ablest among us with a wholesome dread of dogmatism in our attempts at interpreting the universe. It has been beforetime suggested that a being able to take up its position at any given distance from the earth and endowed with an indefinitely increased power of vision, might see the past history of our earth pass in a strange panorama. But Mr. Poynting improves on the idea. He supposes an observer travelling to or from the earth at speeds comparable with that of light. Time would appear to be altered in scale, and even to be reversed. "If the observer were to quicken up his speed till he received twice as many luminous vibrations in the same time, the present colours would all move quite out of the range of his vision beyond the violet, and would be replaced by those long waves beyond the red, which we can now only perceive by their heating effects. The earth itself sends out such rays, and it would most likely appear to be a red-hot globe, while boiling water would be of dazzling brightness." On the other hand, by receding from the earth at a proper speed, but with his eyes still turned towards it, he would see the conclusions of events before their beginnings. These considerations, especially if taken in connection with certain suggestions made by Mr. W. Crookes, F.R.S. ("Journal of Science," 1879, p. 34), will show us what is the true nature, not merely of matter, but even of time and space.

"Another Point of View" is a sarcastic, but, we fear, too lifelike sketch of students and of their doings in certain colleges.

At a meeting of the Union a debate on the Vegetarian question is reported. Miss B. Clarke, who introduced the subject, made the curious assertion that the deficiency of nitrogen in vegetables was to be made up by eggs, *butter*, and cheese, forgetting that butter has very slight claims to be called a nitrogenous body, that, like eggs and cheese, it is an animal product, and that all these three substances could be had only at prohibitive prices if the slaughter of fowls and cattle for food were to cease.

What shall we say at finding a ghost story, the scene of which, moreover, is laid near agnostic Birmingham ?

A passage is here quoted from a letter of Edward Gibbon's, which conveys a wholesome lesson to those anxious to introduce theological discussions in such societies as the Mason College Union. Said the great historian to Joseph Priestley, "Leave Thaumaturgy to defend itself; it is chemistry which will make your reputation. Remember the end of your predecessor, Servetus. If his book on the Trinity is still preserved, it is only because it contains the first rudiments of the discovery of the circulation of the blood."

Footprints found at the Carson State Prison. By H. W. HARKNESS, M.D. (Reprinted from the "Proceedings of the California Academy of Sciences," August 7, 1882.

MOST of our readers will by this time have heard mention, more or less definite, of the strange footprints recently brought to light in the State of Nevada, and which must rank amongst the most important pieces of evidence yet brought to light in favour of the high antiquity of the human race.

It appears that the Nevada State Prison lies at a distance of about a mile-and-a-half from Carson City, the capital of the State. In order to utilise the labour of the convicts in quarrying building-stone it was built on the extreme point of a hill of sandstone, evidently formed by the detritus brought down from the Sierra Nevada by the action of wind and water. From the side of this hill the stone has accordingly been cut away from an area of about 1¾ acres, and to the depth of 15 to 32 feet. The hill consists of layers of rock alternating with seams of clay. In one of these, which now forms part of the Prison yard, the footprints in question were detected. The impression produced upon the observer is that the deposit in which the footprints are seen must have been at one time the muddy shore of a lake or pond, and that various animals, in traversing this deposit, left deep impressions of their feet,—precisely such as may be seen whenever a man or other animal walks over wet mud. The footmarks are those of an elephantine animal (probably the mastodon), a deer, a wolf, perhaps a hyæna, several birds, and, above all, of a man, or at least of an anthropoid biped. Of human tracks there are six distinct sets, each consisting of from 1 to 17 prints, and each showing the impression of a sandal or rude shoe : in one of the sets the shape of this sandal was different from the others.

Some of these series of footmarks disappear beneath the walls of the quarry, but Mr. Garrard, the Governor of the Prison, who has taken an intelligent interest in the discovery, has run a tunnel under the face of the rock, and brought to light eight more footprints, four of which were found in the presence of Dr. Harkness.

According to Professor Le Conte, who has made a careful examination of the traces and the accompanying fossils, the deposit must be either Quaternary or Upper Pliocene, since no elephant or true horse is found in the American Miocenes. The evidence seems altogether in favour of the Quaternary or Upper Pliocene passing into the former.

On this part of the question there is a tolerable unanimity among the highest authorities. But it is asked:—Are we sure that the footprints are human? The size of the prints is the first difficulty. They are eighteen, and in some cases twenty, inches in length, and about eight inches in width. This seems at first sight a fatal objection. But if, with Dr. Harkness, we suppose the foot covered with a large clumsy shoe, it is perfectly possible that the tracks would be much larger than those made by a man walking with naked feet upon a comparatively firm ground, *e.g.*, a hard rock covered with a slight sprinkling of snow. It is especially to be noted that there are no marks of toes, claws, or hoofs. Professor Le Conte, however, remarks that no toe-marks or pad-marks were found in the tracks of the elephants.

Two other points have to be taken into consideration—the length of the stride and the width of the straddle. The stride is 2½ feet, "about the stride of an average man in a brisk walk," but in others more than 3 feet. This Prof. Le Conte considers too much for a man walking in soft mud. We have our doubts on this point: in boggy ground men often take extra long steps for the purpose of avoiding the wetter places. The width of the "straddle" is a greater difficulty. If we draw lines through the centres of the left and right feet respectively, these lines are about eighteen inches from each other. This is fully three times greater than that of an average man. But we have to consider in how far men wearing clumsy wooden sandals would get into the habit of walking with the legs wide apart. Another point to be noted is the outward turn of the foot, which, according to Prof. Le Conte, is "more than human." It will be remembered that the Red Indians, like all men who walk much among brushwood, deep herbage, &c., do not turn their toes outwards.

But if the human theory is not free from difficulties, the quadrupedal supposition is still more perplexing. As Prof. Le Conte says:—"The one strong argument for the bipedal theory is the singleness of the tracks and the absence of toe-marks. The one strong argument for the quadrupedal theory is the wide space between the right and left series of tracks." Whilst suspending his decision, he inclines to the notion that the tracks were due to a bear, or to the Mylodon, an extinct gigantic ground sloth.

Professor Marsh seems of the same opinion. On the other hand, C. Drayton Gibbes writes :—" Many frontiersmen of great experience in tracking Indians, and also bears and other wild animals, have witnessed these footprints, and all give their judgment without a question in favour of their human origin." Dr. Harkness expresses himself also as satisfied that the tracks are those of men. He remarks, very acutely, that if the impressions were those of any unshod animal, be it mammalian, biped, quadruped, or bird, they might differ in size, but would all be of the same pattern, which is not the case. Such a difference in shape becomes, however, quite intelligible if we suppose the footprints made by men wearing rudely-fashioned sandals.

The Students' Mechanics. An Introduction to the Study of Force and Motion. By WALTER R. BROWNE, M.A. London : C. Griffin and Co.

THE work before us, although especially designed for the use of students, has the valuable peculiarity of being non-examinational. The author, in his preface, remarks that the successful prosecution of Mechanics, especially as applied to practical construction, chiefly depends on the obtaining a clear and thorough mastery of a few leading principles, such as the composition of forces, the principle of moments, and the doctrine of energy, which are necessary for the solution of almost all the problems of ordinary practice. He takes occasion to add that whilst it is " easy to learn such propositions sufficiently for the purposes of an examination, it is by no means easy to know and understand them so thoroughly as to be able to use them freely and confidently in attacking questions of practical importance." His object is to assist the student in attaining such a true practical knowledge. He therefore brings forward the doctrine of central forces and the conception of energy at the very outset. We are bound to admit that his treatment of the subject is happy, and that students of fair intelligence, and desirous of gaining a genuine mastery of mechanical science, will find here what they require for their guidance.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

FANCIES.

To the Editor of the Journal of Science.

Sir,—What are fancies? Are they not a struggling evolution of the mind? But men of Science despise these "fancies wild,"—this "poetry." Newton called the latter "ingenious nonsense"; but somehow the mind will keep creeping back to it; and has it never done a stroke for Science herself? "Fancy" can only suggest; it has no reason; it is the speaking of an inner mind, as it were, with which we have no definite connexion, or at least *fancy* so. Locke is harsh on the man that pretends he thinks in his sleep—pretends that thought is going on while "sensation" and "reflection" are at rest (as I take his "Essay," Book II., chap. 1). Yet how do men call out in the depth of sleep (when fancies are at their highest?), and often intelligibly? Evidently there *is* thought at work, working on previously acquired sensation maybe.

One is apt to ask, or fancy, as he gazes on a sleeper, Is that a remnant, left by evolution, of the old inanimate nature—lifeless dust? Is it temporarily passing through a stage inconceivably old in its experience? Does the tree sleep with never a waking? Surely a sleeping man is in something of that phase? Yet he thinks in it, although his memory does not retain anything. Our dreams are only remembered as we dream half awake,—sensation at work without correct reflection: the first "mind" was perhaps always "dreaming." Does a brute think correctly? The dog follows a scent, but it is continually reminded of it by its senses.

Why does the mind picture some objects more readily than others? Thus it is easy for me to clearly see in my mind's eye (though I find it difficult and curious to fix its locality) a chequered square with quadrants of four different colours; but let me attempt to *retain* any of the female faces I may conceive above a second alike, and I cannot do it. The brain is more used to the one than the other, showing probably the work of evolution in the mind. Some say that all our understanding is the result of experience. Whence then came the impulses that cause a mere tiny babe to twist its face into the regular form of a "smile," when it might just as readily have assumed what an experienced mortal would call a "howling contortion"? But it is invariably the same; nor does it appear to be an easier position of the muscles than serenity—or howling.

Can we conceive what never was, *i.e.*, what our mind has not been able to compass with the senses at its disposal? If we are creatures of Evolution, how can we? Witness our thoughts of Time and Space; we cannot "*think* them." Our ideas of "heaven" and "hell" are extremely material; in the old Mystery plays they dressed up God—like the Pope!

The Spiritualist's idea is of something like a jet of steam—a vapour; it's only getting a little warmer! In fact we must have a parallel to speak from, all earthy and Earthly. How can we, then, conceive of the Sublime in the Hereafter, if we inherit it? Can we not see the possibility of a state of "things" we cannot possibly conceive? We are afraid to meet that great Strangeness we fancy will supervene after our decease; but we don't *know*, we have n't the least conception of what it will be: all our heavens are mere beautiful earths; "eye hath not seen, nor ear heard" is truer than we idly dream. 'Tis said the whole world is *in* our brain, a mere set of nervous concussions in this brain-box—that is life and being! The beautiful, hard-soft, sweetness and sour, music, the landscape, the passions, existence, love, the world, the glorious firmament on high, with all its blue ethereal sky, are what? Mere forces acting on our blind "grey and white matter." And yet knowing this, seeing it, we are still vain creatures, knowing not only all about ourselves, but also all the ins and outs of the plans of the Almighty: truly a big fancy!

The other day I read of a tree that "was in a fury and trembled with rage" at being transplanted. "Oh," you say, "there is a physical explanation for all this; some currents set up, or something." Well, then, that 's all we are!

Can we fancy that the existence of thought will ever be proved in plants? Is not "reflex action" thought, or something very like it? Another sense would probably kill us with terror in a few hours. We cannot be so ridiculous now-a-days as to fancy we are not capable of it. I was at a social gathering the other day, and saw gentlemen and ladies bolt straight up in the air for often 4 and 5 feet high, by mere expectancy and laying on of hands; three were enough. Can anyone tell me the reason of that? There is no fancy in what we see!

Altogether one is inclined to treat "sensible" fancies considerately, and, instead of calling it a diseased imagination, to think it may perhaps be a peep in at the future.—I am, &c.,

D. Y. C.

THE BRAIN THEORY OF MIND AND MATTER.

To the Editor of the Journal of Science.

Sir,—As I have been absent from England for some time, the May number of the "Journal of Science," containing a letter on the above subject from "T. P. L.," has only just come into my hands, and I now ask permission to make a brief rejoinder.

"T. P. L." will find his problem already solved, and his "conclusion" refuted, in an article entitled "Animal Automatism," which appeared in the "Journal" for April, 1882, so that only a few words of explanation are here necessary. I have said that all perceptions are merely subjective, and that the brain, *considered as a phenomenon*, must share in this subjectivity, but I have not asserted that nothing exists save perceptions. That would be equivalent to a denial of the possibility of any kind of action, or even of continuous and valid thought. Every man is forced by analogy to believe that there are human perceptions other than his own, but not generically different, and expressed by such signs and sounds as accompany his own moods of thought and feeling. By means of these tangible, visible, and audible symbols he holds intercourse with his fellow-creatures. Now, by acting upon that aggregate of physical phenomena called the body, he can modify the correlated psychical phenomena. Pain, for instance, can be relieved by the administration of suitable remedies; but if the body existed only as a phantasm in the mind of the physician, no modification of the passive mental picture could possibly affect the sensations of the patient. We must therefore conclude that the body has not merely a phenomenal, but also a real or noumenal existence; and as all feeling and thought can be ultimately traced to the grey matter of the cerebral hemispheres, it may well be said of the brain that it thinks, and therefore is.—I am, &c.,

C. Arden.

COSMIC DUST.

To the Editor of the Journal of Science.

Sir,—The lines of dust visible in houses in England pervading the streams of light which enter windows, or accidental apertures in doors or shutters, have been accounted for by the hypothesis of Cosmic dust, which, as is said, pervades space, and consequently our atmosphere. If in England, then, also in Borneo. As a matter of fact, however, no such visible lines of illuminated dust are observed here. The houses of at least half the inhabitants of Borneo are built by the sides of rivers, on muddy banks, surrounded by forest. They are constructed of wood, the flooring generally quite 20 feet above the ground (Swiss lake dwellings), more often 40, and the walls and roofs are made of leaves of palms. It naturally enough often happens, especially after a blow, that apertures larger or smaller are made in the roof. The sun and sky may be seen through these apertures, and upon the floor may be observed a corresponding circle or oval of light, according to the time of day; but no connecting illuminated line. When one blows the smoke of a cigarette across the line of connection, *that* becomes at once illuminated. Therefore the theory of Cosmic dust should perhaps be no longer entertained.

And here occurs to me a query. How many of Mr. Editor's molecules would go to make up a particle of this Cosmic dust made visible to us by a line of light traversing a comparative darkened chamber? And again, How much of the sun's light and heat should we enjoy were space filled with such gross stuff? —I am, &c.,

Ol. de Crespigny.

NOTES.

In a scientific, and as we always thought non-political, contemporary we find an entire page devoted to the recent abortive "Affirmation Bill!"

If the "Academy" is not misinformed, the Canadian Collector of Customs has recently seized and confiscated a set of the works of Professors Huxley and Tyndall, and of Mr. Herbert Spencer, as "immoral and irreligious." So the British Empire still has a censorship of the press, administered not by scholars and thinkers, but by revenue officers! Happy thought: may it not be necessary in future to "examine" candidates for the Customs in criticism, ethics, and theology? Let a certain Department take this into due consideration.

Dr. Krause ("Kosmos") considers the close resemblance of certain moths (such as the so-called "humming-bird hawkmoth," and especially to *Macroglossa Titan*) is due to positive mimicry. The close resemblance may, it is suggested, protect the moths from the humming-birds which are apt to attack them. (But humming-birds, even of different species, attack each other.)

M. V. Burq ("Comptes Rendus") confirms the reported immunity of workers in copper from cholera and typhoid fever. The *Bon Accord* trade society, consisting of 300 to 400 bronze-turners, fitters, &c., has not, since its foundation in 1819, lost a single member by either of these diseases.

The epoch of wheat-harvest, in France, is retarded by three days where the altitude exceeds 100 metres.

Dr. Dœlter ("Petermann's Geog. Mittheilungen") finds that the Cape Verde Islands contain, along with eruptive rocks, limestones, slates, gneiss, &c., and have probably once been connected with the continent; not, however, directly opposite, but in a northern or north-eastern direction.

MM. Wroblewski and Olezewski ("Comptes Rendus") have obtained nitrogen as a colourless liquid by cooling it down to -136° F., and gradually releasing it from a pressure of 150 atmospheres.

M. E. Cosson ("Comptes Rendus,") still combats the projected creation of an inland sea in Northern Africa, as, if practicable, of little utility.

M. Ch. Brongniart has published a treatise on a new fossil insect from the carboniferous strata of Commentry, and on the entomological fauna of the coal-measures.

According to M. R. Blanchard (" Comptes Rendus ") the pyloric appendages of fishes digest energetically cooked starch ; they act more feebly upon raw starch, and transform the albumenoids. They cannot emulsify and split up the fats, and are imperfect representations of the pancreas.

Dr. Langendorff (" Archiv. Anat. Phys.") asserts that in insects the nerve-centre for respiration is not in the head, as they can breathe for some time after decapitation.

The strange account of a haunted house in Berkeley Square, which we extracted some time ago from " Light," re-appears in the " Squire," though in a slightly different form.

Dr. Gerlach (" Naturforscher "), in an investigation on double monstrosities, shows that the presence of two *areæ pellucidæ*, of two distinct germinal vesicles, upon one yolk, is distinctly established. In Mammalia the confluence of two embryos during their development is possible.

According to H. H. Smith (" American Naturalist ") some of the wild honeys of Brazil are violent purgatives, and some even decidedly poisonous.

It is said (" Light ") that a spring of water flowing at the rate of 1000 gallons hourly has been discovered, at Avonmouth Docks, by means of the divining-rod. A Mr. Lawrence made he search.

Prince Bismarck has made the grimmest joke of the century. He has given in his adhesion to Anti-Vivisectionism ! Our Bestiarian enemies must be proud of their new pervert—the man of blood and iron.

Some members of the Society for Psychical Research appear to have been mesmerising birds. They must beware lest this should be construed as a " painful experiment."

Dr. H. Müller (" Kosmos ") finds that blues, violets, and certain reds are more attractive to bees than other shades. Scarlets, oranges, and certain bright yellows, which the author calls " fulgent colours," are unattractive. (These colours, as we have not long ago pointed out, are often accompanied by unpleasant odours.)

According to MM. E. and H. Becquerel the mean annual temperature of soil covered with turf is higher at the depth of 0·05 metre than that of similar soil denuded of vegetation, by 0·29° C.

Mr. A. E. Verrill ("Science") calls attention to parental instinct as an important factor in the evolution of species. The absence of this feeling may have greatly contributed to the extirpation of many powerful forms.

The Bestiarians have had a field day. Lord Shaftesbury and the Bishop of Oxford made themselves conspicuous, and Lord Coleridge "attended to take his share of the scorn and contempt which men of Science were ready to bestow,"—and which he has certainly done his best to merit. The gathering was of a very aristocratic character.

The "Stock-keeper" (which, by the way, lies under some suspicion of Bestiarianism) has a discussion on Prof. Thury's theory of alternate predominance of the sexes in successive generations. The editor seems to think that the ova are arranged in the ovaries in alternate order. "Ixion" and M. Dewsland show the baseless character of this supposition.

Mr. W. L. Carpenter, in a paper on "Science Demonstration in Board Schools," read before the Physical Society, denounced the present system of cramming for examinations.

"Vera," writing in "Light," pronounces Spiritualism "a field bristling with the most diabolical dangers to the human race."

M. Kanellis ("Comptes Rendus") establishes the distinction of the two functions of the liver; the epithelium of the interlobular tissue secretes the bile, and the cellules of the liver form the glycogenous matter.

M. Barthélemy ("Comptes Rendus") has studied the development of some eggs laid by a hen suffering from poultry-cholera. None of them came to perfection, and the blood of the chicks swarmed with bacteria.

Messrs. Powell and Lealand have recently produced a 1-12th oil-immersion objective having a numerical aperture of 1·47, 1·52 being the extreme theoretical limit: this is the largest aperture hitherto attained. The glass has, considering its short focal length, a large amount of working distance; the front is set in the usual way, instead of being mounted on a thin plate of glass, as has been hitherto the custom with oil-immersion objectives.

A rare slug which appears peculiar to Hampstead, Highgate, and Hanley Road, is said to give a slight electric shock when touched, occasioning a momentary numbness in the finger affected.

It has been noticed that in the neighbourhood of Epping Forest the starlings have taken to line their nests with the flower of the red garden daisy.

We find that some persons who are particularly sensitive to the bites of gnats and midges experience a return of the original irritation at regular intervals of twelve or of twenty-four hours. This fact seems to corroborate the view that gnats and mosquitoes are the bearers of malarial fever.

According to "Light" the Pope has fulminated against Spiritualists a curse little inferior in intensity to that which bears the name of Ernulphus.

A new journal, the name of which it is not necessary for us to mention, is winning favourable opinions in certain quarters by taking up a position unfriendly to Science, and talking about "Professor Hoaxley."

M. L. de Wecker ("Comptes Rendus") shows that the infusion of the seed of the jequirity (*Abrus precatorius*) contains a bacillus which, if applied to the human eye, produces purulent ophthalmia. This is the first instance of the transmission of an infectious disease by a plant.

Dr. O. Dammer ("Isis") has been engaged with experiments on the changes of colour produced in flowers by ammonia and sulphurous acid. He does not appear to have studied, like Mr. Nesbit, the action of other reagents.

The French ship *Talisman* set out on June 1st for the purpose of exploring the zoology of the regions of the Atlantic extending from the coasts of Morocco and the Canaries to the Cape Verde Islands, the Sargassian Sea, and the Azores. The head of the expedition is, as might have been expected, M. Milne Edwards.

According to "Science" the European sparrow displays much adroitness in robbing the American robin of its booty of earthworms.

A "familiar" of a certain Department thinks that if the fish-salesmen were compelled to pass a "stiff exam." before exercising their trade, the ring and its monopoly would come to an end. Possibly so; we have heard less likely results anticipated from examinations.

The Bestiarians held a conference at Edinburgh on May 26th, and expressed their "alarm" at the sensible conduct of the Home Secretary. May their alarm increase!

MM. Dujardin-Beaumetz and Audigé ("Comptes Rendus"), in a series of experiments, have confirmed the specially dangerous nature of absinthe as compared with ordinary alcoholic liquids.

M. Chicandard ("Comptes Rendus") shows that the fermentation of bread does not consist in a hydration of the starch, and is not occasioned by a *Saccharomyces*, but depends on a transformation of a portion of the insoluble albumenoids of the gluten into a soluble state, and ultimately into peptones. The starch is only modified by baking. The agent in panary fermentation is a bacterium which is normally developed in the paste ; yeast merely accelerates the process.

MM. Van Tieghem and Gaston Bonnier (Société Botanique de France) show that grains of rye retain their power of germination even after desiccation at 176° F.—a temperature higher than that at which albumen is coagulated.

M. Pauchon (" Comptes Rendus ") demonstrates that the upper limit of audibility may vary, for one and the same ear, with the intensity of the sound. Using a powerful syren, he found that with a pressure of steam varying from 0·5 to 1·5 atmospheres the limit ranged from 48,000 to 60,000 single vibrations; with a pressure of 2½ atmospheres the limit was not reached at 72,000 vibrations—the acutest sound which the syren was able to produce.

The French Government, in acknowledgment of the merits of Professor Pasteur, have increased his pension from £450 to £1000 yearly, and extended it to his wife should she outlive him.

MM. Fränkel and Geppert have studied the influence of reduced atmospheric pressure upon animal life. They find that at pressures corresponding to an altitude of 3800 to 4900 metres the proportion of oxygen in the blood is not diminished. At ⅓ atmosphere, corresponding to an altitude of 8800 metres, the arterial oxygen is reduced by one-half. The formation of carbonic oxide is reduced, but not in a corresponding proportion. The decomposition of albumenoids in the body, and consequently the excretion of nitrogen, are increased. The loss of blood from the mucous membranes is not due to direct mechanical action.

It is not generally known that the botanist A. M. Duchesne, as far back as 1766, upheld Evolutionary ideas, and even constructed a genealogical tree of the strawberry. He writes :—" L'ordre genealogique est le seul que la nature indique, le seul qui satisfasse pleinement l'esprit ; tout autre est arbitaire et vide d'idées."

Mr. J. Amory Jeffries, writing in " Science," contends that Madagascar should be regarded as the remains of a fading zoological region, rather than a part of the Ethiopian.

Mr. J. Le Conte (" Science ") shows that in very cold climates the sap of all perennial plants must be frozen in all parts during the winter months. Such congelation does not necessarily involve the death of the plant.

According to the experiments of Ewald and Kobert the lungs are not absolutely air-tight at high pressures (" Pflüger's Archiv.").

M. Netter professes to demonstrate experimentally the non-intelligence and the automatism of animals. He appears to have overlooked the circumstance that his demonstration, if valid, applies also to man.

The removal of the Geneva museum to a new building has, we learn, proved ruinous to a considerable part of the entomological collections. Let us hope that a better fate awaits the British Museum in its place of exile.

M. Cattaneo, in an elaborate work, combats the view of Perrier that the Mollusca, like the Articulata, are formed by the amalgamation of linear colonies.

Dr. de Chaumont (" Medical Press and Circular ") in an interesting paper on the " Origin and Development of the Science of Hygiene," says—" Of the other writers of the period I will only refer to Thomas Philogus, of Ravenna, on account of his strong protest against intramural interment, thus anticipating by some three centuries the happily fruitful labours of our distinguished countryman Edwin Chadwick." Can Dr. de Chaumont have forgotten that the modern and successful protest against intramural interment was made by our distinguished countryman Dr. George Walker, once known all England over as " Churchyard Walker " ?

Prof. Feser, by feeding rats exclusively upon animal food, rendered them incapable of contracting, by inoculation, splenic fever, to which other rats, fed on a vegetable diet, easily succumbed.

A writer in " Les Mondes " divides Evolutionists into three classes :—1. The atheists ; Haeckel, Vogt, Büchrer, and their school. 2. The gnostic or positivist evolutionists ; Herbert, Spencer, Tyndall, Huxley, Bain, and Littre. 3. The theistic Evolutionists ; Owen, Sir John, Herschel, Sir William-Thomson, Prof. Gray, M. Vallace, M. Naudin." (We copy these names literally. It might be asked whether Sir J. Herschel and Sir W. Thomson have ever professed themselves Evolutionists, and also why the name of Darwin himself is omitted? A positivist Evolutionist is, since the death of G. H. Lewes, a rarity.)

Dean Swift's famous college of Brobdignag could not be more machine-like in its method of working than is the unwieldy thing we may call our modern system of education, with its standards and certificates, and payments by results, &c. But what are these results ? We could understand there being some value attached to a good result. The result, however, is not education ; it is cramming, accompanied by enfeebled brain and waste of nervous tissue.—*Yorkshire Inventor.*

M. Gay-Lussac, son of the illustrious chemist Gay-Lussac, died early in June, at the age of 63 years. The deceased was a chemist of merit, and had published important researches in metallurgy.

Dr. Burdon-Sanderson, on his appointment to the Wayneflete Chair of Physiology, at Oxford, was very naturally desirous for his laboratory to be enlarged and improved. At a meeting of Convocation a grant of £10,000 from the University chest was proposed for this object. After much discussion the motion was carried only by the narrow majority of 3 ! The opposition is said to have been under Bestiarian influences.

Dr. Michael Foster is appointed to the new Chair of Physiology at Cambridge, and Dr. A. Macalister to that of Anatomy.

Twentieth Year of Publication.

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THE
JOURNAL OF SCIENCE.

AUGUST, 1883.

I. WASTE.

IN our last number we gave a few scattered instances of Nature's seeming wastefulness in the world of life. We will now seek to trace a similar want of economy in the management and preservation of heat. Two points will be admitted at the outset—that certain temperatures ranging from 32° F. to about 100° F. are necessary for the existence of, at least, all the higher forms of animal and vegetable life; and secondly, that the universe is, as a whole, very poor in this primary requisite. As far as our physicists are able to calculate the temperature of the vast regions of space, lying between sun and sun, and even between sun and planet, is about $-273°$ C, or 470° F. below zero—a degree of cold which no living being with which we are acquainted could possibly survive. Being then so necessary,—in fact forming the working capital of the universe,—and so scanty in its amount, we might fairly expect that it would be carefully utilised, and that its loss would be jealously guarded against. This, however, is precisely what we do not find. The only sources of heat of which we are aware are those large luminous bodies of which our sun is the most familiar instance. These orbs, in conventional language, radiate light and heat in all directions. But this radiation does not at all warm the depths of space through which it passes; it is only when it impinges upon solid bodies like the earth's crust, or traverses certain gases and vapours, that the effect which we call heat is produced. To what an extent this holds good we learn from the experience of mountain-climbers and aëronauts, who, in proportion as the air becomes rarefied, find the sun's rays losing their power. But the proportion of the sun's radiations which fall upon any of the planets is an infinitesimal fraction of the whole. The bulk of the energy evolved is, as far as warming planets is concerned, simply thrown away. If we were to kindle the largest fire that ever blazed in the kitchen of a feudal castle, and to suspend before it a gnat, our extravagance would be a type of what is actually going on in the relations between sun and planet. Still this is a point upon which we can lay but little weight, since, for anything we know, the sun may have other and more important functions than the illumination and warming of the planets. Therefore, in spite of the aphorism *de non apparentibus et non existentibus eadem est ratio,* a suspension of judgment is here prudent.

Let us turn now to that portion of the sun's rays which falls upon the surface of the earth. It is known that heat-rays as given off from the surface of incandescent bodies, such as metals at a white heat, or as in the case in point, pass through the various gases and vapours which form the earth's atmosphere with little loss, so long as these are transparent.* They are, however, to a considerable extent intercepted by aqueous vapour in that condition in which it forms mists and clouds. Hence the earth's crust during the day-time is much more heated if the sky is clear than if it is overcast, a fact familiar to everyone. With the heat radiated out from bodies at lower temperatures, such as from a pipe filled with boiling water, the body of a living animal, or the surface of the earth after exposure to the sunshine, there is a decided difference. Such radiations do not readily traverse glass, watery vapour, even if transparent, and carbonic acid gas; whilst through certain other gases, such as oxygen, nitrogen, and especially hydrogen, they pass with comparative ease. These differences explain why a glass house, such as a conservatory, retains the heat which it receives from the sun, or from steam- or hot-water-pipes. The rays of the sun pass easily through the glass, and warm the objects within. On the other hand, the low-tension heat-rays thrown off from the walls, floor, &c., heated by the sun or from the hot-water-pipes, is to a great degree imprisoned. Still more strikingly is this shown in the so-called "solar engine." A boiler with a blackened surface encased in glass is exposed to the sun's rays, which enter readily and heat the metal and the water. Again, the low-tension rays from the surface of the boiler cannot readily escape, and the water is thus brought to a boil. In cloudless regions a steam-engine may thus be made to work.

---

* Transparent watery vapour absorbs about 10 per cent of the sun's rays.

The same facts play an important part in Nature. During the day, as we have already seen, the earth is gaining heat, if only the sky is clear. During the night there is a loss going on, the heat which has been collected during the day being dissipated by radiation into space. This loss, which is always experienced to some extent, is greatest when the sky is cloudless by night, as is always observed in case of the spring-frosts so much dreaded by the farmer and the gardener. Hence, for the earth to receive the greatest possible effect of the sun's rays, the sky should be clear by day and overcast by night. But, in England at least, we might almost say that the very reverse order prevails. The sun is visible but for a part of the time when he is above the horizon,—in some seasons not more than one-fourth,—whilst the heavens clear up at night. Were accurate observations made we suspect that the sky would be found cloudless by night for twice as many hours yearly as in the day. Here, therefore, we have a double loss: a large part of the sun's rays are shut off from us by day, whilst by night the heat which the earth possesses is allowed to escape freely. Here, then, is twofold waste on a gigantic scale. So fully has the evil of clear nights been recognised that in many parts of the world it has been customary to protect orchards and vineyards from night-frosts in spring by making a dense smoke to the windward.

Transparent watery vapour is also a great protection against the nightly loss of heat. Where it is wanting, no intensity of solar action by day is able to ward off frost, even within the tropics. In the deserts of Africa, Arabia, and Persia travellers often experience bitter cold before sunrise. The so-called "extreme" climates, where a scorching summer alternates with a severe winter, have a comparatively dry atmosphere. The chills of the easterly winds of March and April, which few of us "welcome," as did Kingsley, owe their evil effects upon man, beast, and vegetation to the same lack of transparent watery vapour.

We have already mentioned the power of imprisoning low-tension heat-rays possessed by carbonic acid, as compared with oxygen and nitrogen. So manifest is this property that some writers have sought to explain the luxuriant vegetation of the Eocene and Miocene Ages, even in high latitudes, by the assumption of a much larger proportion of carbonic acid in the atmosphere than exists in our days. In all probability it may be said that if nitrogen possessed the same property of preventing the escape of the low-tension heat-rays as does carbonic acid, frost would be unknown outside the polar regions, and the Arctic ice-cap would not be able to send us cold currents of air and water to the ruin of our crops. The attributes of our atmosphere form, then, an additional source of the waste of heat.

There is another process by which the soil is locally chilled, even if the total sum of heat in our globe is not reduced. If drops of water, such as rain, fall upon a porous soil, they sink in and draw with them mechanically a portion of air which becomes condensed in the soil, and by this means, as well as by the chemical action of the oxygen present, raises the temperature of such soil. But if immediately after the rainfall a strong wind arises, as is very frequently the case, this process is very gravely interfered with. The stronger and drier the wind, the more of the water which has fallen, instead of sinking into the soil, evaporates from the surface. For its conversion into vapour a quantity of heat, taken from the soil, is rendered latent, and thus vegetation is chilled and more or less injured. Every experienced gardener, when working with plants under glass, and consequently completely or nearly so under his control, takes good care immediately after watering to shut the frame or the house up close, so as to minimise evaporation and give the water time to disappear from the surface of the soil by absorption.

To carry out this method of working in Nature would, however, involve a serious difficulty. For rain is due to watery vapour becoming condensed into the liquid state and falling to the earth. By condensation it necessarily occupies less room and a partial vacuum, or at least, a reduction of pressure being thus created, air rushes in from other districts to restore the equilibrium. Hence the prevalence of wind after rain, ruinous to vegetation as experience no less than theory proves it to be, seems, according to our present knowledge, a physical necessity.

We come now to some points connected with the behaviour of water when in the solid state, as ice and snow, which involve no inconsiderable waste of heat. When these substances melt an enormous amount of heat is rendered latent, being withdrawn from surrounding objects, from the lower stratum of the air, &c. We might at first sight think that a pound of ice or of snow at 0° C. would be easily, and at little cost, transformed into a pound of water at the same temperature. Not so: as much heat is required as would raise a pound of water from 0° to 80° C. It may be argued, on the other hand, that when a pound of water at 0° C. is converted into ice at the same temperature, exactly the same amount of heat, previously latent, is liberated, and that a balance is thus kept up. This is certainly true; but snow is formed not on the surface of the earth, but high up in the air. The heat liberated in its formation is therefore emitted into the upper regions of the atmosphere, radiated into space, and wasted.

But snow has further vices in relation to heat. When exposed to the direct action of the sun it is very little affected, hurling back into space, and wasting a very large proportion of the incident rays. Hence it has been observed to remain unmelted in Arctic regions, even though the sun was powerful enough to soften the pitch in the seams of a boat: it melts only where low-tension heat-rays are reflected upon it from rocks, walls, and other solid objects not buried in snow, or, on a larger scale, when warm winds blow from some milder region.

If, on the other hand, snow lies in a country where the atmosphere is rich in watery vapour, it condenses the moisture into mists and clouds, and thus excludes the rays of the sun. Hence snow has been well styled a striking instance of an effect which perpetuates and increases its own causes. Being produced by the want of heat it extends and prolongs that want. The polar snow-caps are fortresses antagonistic to life, and which the sun is unable to storm. From them issue constantly, season by season, those huge masses of icebergs which float down into the temperate, and almost into the tropical, seas, and which rank among the main causes of cold unfruitful summers in Western Europe. We have sometimes thought that if water had solidified in deep blue instead of colourless crystals the perils of glaciation would have been greatly diminished, as such snow would have more readily absorbed the sun's rays, and have in consequence been liquefied.

The very figure of the earth is doubtless a necessity if the planets have been formed by the gradual condensation of a fluid or semi-fluid mass whilst revolving upon its axis; but as regards the reception of heat from the sun it is decidedly unfortunate.

If we wish a body to be uniformly heated whilst revolving around or before a focus of combustion, we select a prolate spheroid approaching the shape of a spindle, with its axis at right angles to the heat-rays. An oblate spheroid, on the contrary, flattened at the poles, receives a much smaller share of heat, except at and near its equator. However, if the origin of the planets was such as the nebular hypothesis teaches, no such shape as the one we have supposed is possible.

As the matter stands a very great part of the earth's surface is useless, from its low temperature. We have the region about the South Pole, roughly speaking, 3000 miles in diameter. We have smaller, but almost equally desolate, districts in the Northern Hemisphere, such as the greater part of Greenland, Novaya Zemlya, Spitzbergen, Wrangel's Land, &c. All these perpetually glaciated regions are worse than non-existent, because they exercise an injurious effect upon plant-life—in Europe as far, occasionally, as lat. 40° N.; in Asia down to the Himalayas and the Valley of the Yellow River; and in North America sometimes even to Texas and Mexico, where the redoubted "Norther" comes down "sword in hand." In South America, not to speak of the deplorable climate of Tierra del Fuego under a latitude not greatly differing from that of Britain, destructive snowstorms at times ravage the Pampas up to 35° S. lat., if not beyond. Similar calamities have been known in the Orange Free State as far as 28° S. lat. So that the belt of territory, within which the vegetable and animal wealth of the country is never liable to devastation by snowstorms and night-frosts, is very little broader, even at the sea-level, than the torrid zone, whilst the spots which have a permanently mild, but not tropical, climate are few indeed. This unsatisfactory state of things—unsatisfactory as limiting the earth's productivity and the population it can support—is due evidently not so much to the quantity of heat furnished by the sun as to the manner in which it is wasted by a number of natural processes.

We will, in conclusion, pass in review a single day of that kind of weather known as "black spring," and which is seldom entirely absent in the months of April and May. For the accuracy of our description we need appeal only to the memory of any careful observer. On such a day the sun rises in a cloudless sky, and shows a hoar-frost, if not upon roofs, rails, &c., yet upon the grass and the buds and blossoms of the trees. Could all vegetation be kept in the dark, or in diffused light, until this frost had melted away little harm would ensue. But under the influence of the sun it thaws rapidly, and the injury done is proportionate to the change of temperature to which the buds are exposed. Did the sun now continue shining, however, the earth would regain some of the heat of which it has been robbed in the night. But about 9 a.m. black clouds appear, and rapidly increase, until the sky is entirely overspread and the rays of the sun are completely shut out during all the hours when they would be most effectual. About 4 to 5 p.m. there falls a smart shower of cold rain, mixed with sleet. The sky then clears up, and vegetation and the soil are left to be chilled by evaporation under the influence of a keen dry wind, and by free radiation under a cloudless sky. Were the most observant and experienced horticulturist challenged to arrange weather more destructive he would be unable to do so, or even to add one ruinous agency which is not present.

II. HEATH'S BOLIVIAN EXPLORATIONS.

By Rev. J. D. Parker.

BOLIVIA unfolds to the traveller the most diversified physical features. Two chains of Cordilleras, running nearly parallel with the coast, carry their lines of snow-clad peaks like sentinels across Bolivia, but are separated by an intervening table-land, from 100 to 200 miles in width, which, when the mountain-chains were folded, was lifted as a connecting plateau more than 12,000 feet above the level of the ocean. On the Pacific slope the descent from the western Cordillera is steep and difficult, terminating in a rainless plain, where no vegetation appears except where mountain torrents margined by narrow valleys force their way to the Pacific Ocean. Beyond the eastern Cordillera stretches eastward for hundreds of miles a vast plain of great fertility, through which with gentle flow thread various affluents to the Amazon. During the rainy season portions of this plain are overflowed, and the vast perennial forests, disclosing glimpses of the watery waste, seem like islands of foliage on some inland sea.

Bolivia, occupied now by two millions of people, and possessing rich mines of precious metals, has sought for centuries to find with Europe a more direct means of communication. Nature has furnished her river outlets connecting with the Amazon, but these have been useless to commerce, because they were unexplored. The products of the vast alluvial plain lying east of the Cordilleras, the largest portion of Bolivia, found a slow and toilsome transit on the backs of mules over two chains of Cordilleras with their barren connecting plateau, and, when once embarked on the Pacific Ocean, made a long voyage around Cape Horn, or through the Straits of Magellan. The exploration of the Beni River in 1880, by Dr. E. R. Heath, was therefore an important event to that Republic, because the natural outlet for the largest portion of Bolivia is through the Amazon and its affluents to the Atlantic Ocean.

Previous attempts had been made to find a river outlet to the Amazon. Palacios, Prefect of the Department of the Beni, was commissioned by his Government in 1846 to explore the fluvial outlets of Bolivia. He descended the Mamoré and Madeira Rivers as far as the lowest fall in Brazil, and ascended the Beni River 18 miles, where a fall placed an obstruction to his further progress. The same year a Prussian named Bursa attempted, with one hundred and fifty men and ten canoes, to ascend the Beni River. According to his report he encountered hostile Indians, and, all his ammunition having been exhausted in conflicts with them, he was compelled to return. His men claim that they ascended the river for thirty days, and were occupied ten days in descending it. As they found no rapids, but discovered a large island where there were hills and floating patches of foam on the river, it is believed they only ascended 12 miles. Lieut. Gibbon was sent out in 1852 by the United States Government, but did not succeed in opening the Beni River.

Prof. James Orton, accompanied by Dr. J. D. Heath, attempted in 1877, as the crowning work of his South American explorations, to unveil the mysteries of this unknown region, over which had hung a superstitious fear for more than three centuries. But his twelve Bolivian soldiers, to whom he had paid in advance 1200 dollars in gold for their services during the expedition, mutinied, on account of their fear of encountering cannibals on the Beni River. While in camp beside the Mamoré, which they had descended in canoes to within 24 miles of the mouth of the Beni, about 4 o'clock one afternoon, they suddenly placed their bayonets at the breast of Prof. Orton, and held them there defiantly a few moments in silence, and then marched off in a body. Taking possession of one of the boats, they drove into it ten of the Indian rowers at the point of the bayonet, and then turned the prow of the boat up stream, and left Prof. Orton to his fate. Forced to abandon his expedition Prof. Orton turned back heart-broken. When he reached

Lake Titicaca, of legendary fame, completely exhausted he threw himself upon some sail-cloth on the boat, and, as if relieved of a great burden, said with deep feeling, "I am so glad, *so* glad. We will have no more mules, muleteers, or Indians; no more annoyance, trouble, or disappointment. I am so tired, *so* tired"; and then quickly fell asleep. During the night a terrific storm burst upon them, and their boat struggled for hours amongst the billows. But just before daylight of the next morning, September 25th, 1877, the tempest lulled, seeming to have spent its force, and Prof. Orton suddenly became conscious that he was dying; and there among strangers, far away from his family and friends, gently, without complaint or a struggle, he died a martyr to Science. He was tenderly buried on a rocky island in Lake Titicaca, in sight of the scenes of his last expedition. A fine monument, erected by foreigners, on the summit of the island, just in front of Puno, is a fitting tribute to this celebrated discoverer, who will be remembered as long as the blue waves of this magical lake murmur around his last resting-place, or the Sorratta range of the Andes, which stand in the background, lift up their snow-clad peaks.

Dr. E. R. Heath, who had been employed for six years as Medical Director of the Pocasmayo Railroad, one of the roads belonging to Henry Meiggs, was, on the return of his brother, Dr. J. D. Heath, who had been the assistant of Prof. Orton, greatly impressed with the importance of opening the Beni River to science and commerce. Two months afterward he left Peru, returned to the United States, and having prepared himself for the expedition sailed from New York, November 23rd, 1878, for Parà. Taking the first steamer he ascended the Amazon to Manaos, and the Madeira to San Antonio, where the Madeira and Mamoré Railroad was being constructed under P. and T. Collins. Here Dr. Heath remained until July 21st, 1879, acting as Medical Director of this road, while he carefully studied the climate, diseases, and natural history of the country, and the customs and language of the people.

Leaving San Antonio at the latter date, he ascended the Madeira River to the junction of the Mamoré and Beni, where he made a *chacra*, or clearing, and planted bananas, yucas, oranges, and lemons. Departing from this point August 20th, he ascended the Mamoré, passing the mouth of the Itenez, a river flowing north-west from the diamond regions of Matto Grosso, and arrived at Exaltacion September 9th, 1879. Continuing his course up the river to the mouth of the Yacuma, he disembarked and left his canoes, and, after the delay of a week at Santa Ana, he secured carts and commenced his land journey across the Pampas to Reyes. During the dry season the journey between these points is made by carts, but the country is flooded during the remainder of the year, and the journey is made by boats on the river.

On September 30th, 1879, Dr. Heath arrived at Reyes, and built a house, and made active preparations for the work before him. To become more familiar with the country he made a voyage down the Yacuma to Santa Ana, and to Lake Rogagua, whose outlet is the River Negro, and also to Tumupaza and San José on the River Tuichi, correcting their geography. He remained at Reyes until August 3rd, 1880, occupied in making collections and in keeping a meteorological journal, when he embraced an opportunity of descending the Beni as far as the rubber camp Maco, near the mission Cavinas. Antenor Vasquez, the owner of this rubber estate, had forty Indians and boats to descend the Beni, for the purpose of discovering new places for rubber camps. Embarking with Don Antenor he descended the river five days to a point where Antenor Vasquez remained with most of his men, and Dr. Heath took a single boat with three Bolivians and nine Indians, and descended the river to a point as far as 11° 11′ 29″ S. lat., where he made a *chacra* and planted bananas, the customary method of showing where a descent had been made on the river. By the river this point is 375 miles below Reyes, and the Bolivians refused to go any further, on account of the general belief that the country contiguous to the Lower Beni was inhabited by cannibals. In passing the last rubber camp Dr. Heath found a family of Pacavara Indians, one of whom accompanied him on the descent, from whom he obtained some knowledge of the character of the Indians who occupy the country as far as the River Madre de Dios.

From this point Dr. Heath was compelled to return to Maco, where he made preparations for a final descent of the river, which he believed could be successfully explored. As no one was found willing to risk his life on the Lower Beni, Dr. Heath determined to make the descent alone. But Don Antenor would not allow this, and offered him any of his men who would voluntarily accompany him. Ildifonzo Roca, a Trinitarian Indian, was the only one found who was willing to go. Dr. Vaca, a Bolivian rubber gatherer, afterward furnished another Indian, and a boat 15 feet in length, which when loaded sank nearly to the water's edge.

The forest along the Beni River on the south side forms a margin from 1 to 10 miles in width, and on the north side it becomes a part of the great Amazonian forest, which extends over 15 degrees of latitude. The Amazonian forest realizes the perfection of vegetable growth, and its magnitude and diversity serve to overcome and bewilder the traveller. The gigantic trees, 200 feet in height, are so thickly woven together at the top that not a direct ray of light can penetrate the dense foliage, and the parasites and vines at the bottom form such a matting and tangle that no one can force his way through except by cutting a path with the *macheta*. This sea of verdure extends from the treeless Pampas of Buenos Ayres to the grassy steppes of Venezuela. Here the law of the "survival of the fittest" is illustrated to its fullest extent, species struggling with species and individual with individual, the weaker growth often climbing the more powerful neighbour while its roots are left to dangle in the air. These unconquered giants exhibit the greatest possible diversity, presenting an endless variety of growths, festooned, draped, matted, corded, and ribboned with plants creeping and climbing, starred with flowers, and covered with parasites. The dense dome of green overhead serves to confine the growth of flowers to the edges of the forest, and to the banks of rivers and lagunes, and the absence of sunlight has probably deprived the few flowers that appear of the bright colours of the temperate zone. The tranquil waters of shallow lakes which border the Amazon, however, produce the royal water-lily (*Victoria Regia*), the most magnificent inflorescence in the world. It expands its broad leaves from 15 to 18 feet in circumference on the water, and unfolds its blossom a foot in diameter, which passes in a brief time from pure white to rose, and through the successive hues to bright red. Dr. Heath and his two Indians were from 6 o'clock in the morning until nearly noon cutting their way from the river through the forest to the Pampa on the south side, a distance of not over a mile, which they retraced in fifteen minutes. When it is desirable to make a clearing in an Amazonian forest a leaning tree is selected, and all the trees in the forest in front of it are cut on one side; then the vines are severed, and the leaning tree is cut down, when all the trees come down with a crash. The vertical rays of the sun soon dry the fallen timber, so that fires will burn up all except the trunks.

(To be continued.)

III. SOME INCOMPLETELY UNDERSTOOD AND SOME ENTIRELY UNNOTICED RELATIONS BETWEEN EARTH AND MOON.

By O. Reichenbach.

IF the mass of the moon surrounded us as a hollow sphere, at its present distance, its action would be different: for similar reasons the nature and distribution of matter within and at the surface of the earth cannot be indifferent for the constitution and motions of the moon. How could a comet so entirely alter its complexion when getting nearer the sun? How could it go in two, or disperse into meteors and mist, or moving from the sun again condense wholly or in part, if its qualities did not depend on position? If the attraction of planets throws comets into new orbits, it must be equally true that the mass and constitution of the comet accommodates itself to its orbit and its adventures.

What is true of a comet must be true of earth and moon. From a long-continuing regular motion we can only infer that new components, very gradually transforming former results, have produced something like a regular clockwork. It is not, for the present, my intention to closely examine and discuss why the relations to be enumerated do exist.

Between the earth and the sun, which has determined the configuration of the earth and rules the circulation of the oceans, the moon is fitted in agreement with the mutual action of sun and earth, and apparently plays the chief part in the familiar phenomenon of the tides.

Long and careful observation has made tidal predictions generally correct; but if this theory were quite true in its premises the height of the flood ought to depend on the extent and depth of the local sea, to decrease regularly with latitude, and to be next to nothing at and beyond the polar circles,—all circumstances, together with various others, not in agreement with facts.

The tides in the syzigies, when sun and moon act in common, are larger than in the quadratures, when the lunar tides are diminished by the sun. The corresponding lunar tides occur in the mean 1·035 days, or 24 hours 40 minutes, that is—

$$1 + \frac{1}{29{\cdot}78} \text{ days}$$

after the other, in conformity with the lunation, except a difference of 1-3546 of a day, the square of the excentricity of the common orbit of moon and earth, and the twofold excentricity of the earth itself. But the former tides occur 39 minutes and the latter 75 minutes later, times which stand in the same relation as the greatest and least tide at any place, the sun being in one case an increasing and accelerating, in the other a diminishing and delaying, power. The time of flood after culmination is therefore always longer in higher than in lower latitudes, because the difference in distance through latitude and the distribution of gravity on the earth tell more against the absolutely nearer moon, with her smaller mass, than against the more distant larger sun.

The greatest flood on each day falls in the mean 3·24 hours after the upper or lower culmination of the moon, but during the syzigies 3·78, and during the quadratures 2·70, later. The reason of the delay is not that the water requires time to collect, for an attracting force will lift as much from where it is going to as from where it comes from if the attracted substance is equally distributed round the attracting force. The cause is that the attracted substance is not equally distributed, the surface of the earth being composed of—

$$\frac{2{\cdot}83}{3{\cdot}83} \text{ parts}$$

of yielding, waving liquid, and—

$$\frac{1}{3{\cdot}83} \text{ part}$$

of arresting, resisting solid, unequally distributed, divided by moving rings of the liquid, the ocean. The time from tide to tide is 12·41 hours, and—

$$\frac{12{\cdot}41 \text{ h.}}{3{\cdot}83} = 3{\cdot}24 \text{ h.}$$

The greatest height of the tide will, however, in the mean fall not more than 3 hours after culmination of the moon, the inclination of the ocean rings to the meridian causing by lateral pressure an acceleration of 1-12·08, reducing the 3·24 hours to 3, the extent of the polar zones being 1-12·08 of the sphere.

This acceleration of 0·24 hour again corresponds to the 15 minutes the tide uses less time in rising than in falling.

The delay of 32 minutes beyond the mean 3 hours during the syzigies, and the acceleration of about 30 minutes during the quadratures (the difference of two minutes being the 1-59·56 of the sum), or the variation of 1·03 hours, is to the remainder, 2·20 hours of the 3·24 hours, as solar is to lunar action generally, the former now increasing and delaying, now diminishing and accelerating, high water. Every particle of the ocean being a moon disturbed by moon and sun in its motion with the rotation of the earth, and in the motion round the earth of that ring of which it is a portion, the sun produces, as he does *with the moon in her orbit*, a retardation on the moving undulation, the tide, in the first and third quadrant (in the octants), and an acceleration in the second and fourth. The highest and lowest tides do not coincide with the syzigies and quadratures, but fall 1·5 days later,—that is, divide the time or tidal effect, for each quadrant in the lunation, in proportion 1 : $(\sqrt{2{\cdot}83})^3$, as the waves dividing oceans and land are divided in harmony with Kepler's laws.

A lunation is 1-12·37 of a year:—

$$\frac{1}{12{\cdot}08} - \frac{1}{12{\cdot}37} = \frac{1}{515},$$

and 515 × 12·37 revolutions of the earth round her axis are equal to the sidereal period of the lunar nodes on her orbit.

The difference of the 1-12·08 of the days of the year and of the days of the lunation is 1-40 of the latter; 1-40 being equal to the extent of a polar zone to the sphere, minus the excentricity of the common orbit of earth and moon to—

$$\frac{1}{24{\cdot}16} - \frac{1}{59{\cdot}56}.$$

The difference between 1-12·37 of the year and 1-13·37, the tropical month, is 1-181; and half the 1-12·08 of the year, or 15·1 days, 181 times, is equal to the tropical revolution of the apsides of the lunar orbit.

The surfaces of ocean and land are 2·83 : 1, their densities being inverse. The lunar terrestrian orbit has an excentricity of 0·01679, and the lunar orbit one of 0·005504, or 3·05 to 1. We have—

$$\frac{1}{2{\cdot}83} - \frac{1}{3{\cdot}05} = \frac{1}{40};$$

and—

$$\frac{1}{40} = \frac{1}{24{\cdot}16} - \frac{1}{59{\cdot}56}, \text{ as before.}$$

The attraction of the earth on the moon varies in consequence of this excentricity, according to observation, from 1-3364 to 1-3844 of the attraction or gravity exercised by the earth at her own surface. The mean being 1-3604, we have—

$$\frac{1}{3604} + \frac{1}{3604 \times 59{\cdot}56}$$

of itself (1-59·56 being the excentricity of the terrestrian lunar orbit, and—

$$\left(\frac{1}{59{\cdot}56}\right)^2 = \frac{1}{3546},$$

the twofold terrestrian excentricity) equal 1-3546. But in "On some Properties of the Earth" I have shown, in more than one way, that the ocean is the 1-3546 of the mass of the earth, and so forth,—certainly a remarkable string of coincidences.

The distance of the moon from the earth is 60·2965 radii, or 30·14 diameters of the latter. The uncertainty in this distance is held to be—

$$60{\cdot}2965 \text{ radii} - 59{\cdot}56 \text{ radii} = 0{\cdot}7365;$$

which difference is the 1-81 of the former and the 1-80 of the latter figure, the mass of the moon being 1-81 of that of the earth. The difference,—

$$\frac{1}{80} - \frac{1}{81} = \frac{1}{6480},$$

is equal to the decrease of solar attraction through the length of the diameter of the earth.

The surface of the moon is to that of the earth as the sideral month to the year, or a revolution of the moon round the earth to one round the sun. The density of the moon is therefore $\sqrt{2{\cdot}83}$ of that of the earth.

The solar attraction, $\frac{M}{D^2}$, at the surface of the moon is so much greater than the terrestrian, $\frac{m}{d^2}$, as the tidal action of the moon, $\frac{m^1}{d^3}$, at the surface of the earth, is greater than the tidal action of the sun, $\frac{M}{D^2}$.

The mean inclination of the lunar orbit on the ecliptic being 5° 8′ 47″, the sinus of this angle, less its 1-12·08 (by reaction) is 1-12·08 of the radius (or stands to it in the same proportion as the height of a polar zone of the earth to the radius, plus &c.). The inclination of the equator of the moon or her orbit is 1° 29′, of which the sinus is—

$$\frac{1}{40} = \frac{1}{24\cdot16} - \frac{1}{59\cdot56}$$

of the radius.

The earth turns 29·58 times round her axis during a lunation, and the moon moves round the earth with a velocity which is the 1-29·58 of the common velocity of earth and moon moving round the sun. The difference of the greatest and least distance of the common centre of both, or of the centre of the earth from the sun, is 1-29·78 of the great axis of their orbit. The difference, 1-3526, of these fractions is the square of the excentricity, 1-59·56 of this orbit, and the excentricity of the earth in the equatorial and polar sense, or the proportion of the mass of the ocean to that of the earth, &c.

The moon, as offspring of the earth, corresponds in her nature and motions to those causes and relations which developed the polar regions and the whole configuration of the earth.

The number of revolutions of the earth round her axis during a lunation is equal to the number of years, less its 1-81, of a revolution of Saturn round the sun (*see* " Development of the Solar System," Gedanken, 1857).

IV. ON THE RECENT PROGRESS OF ELECTRICITY.*

By W. Fraser, M.R.C.S.

AN apology may be expected for my bringing before you a subject not strictly medical, and I quite admit the validity of the objection. But, although Electricity has never been so far professionally recognised as to have a place in the Pharmacopœia, we all know that it has long been employed, both as a diagnostic and a therapeutic agent, and that of late it has proved to be a valuable method of treatment in the hands of several eminent London physicians.

We know, too, that in the present period of popular electric excitement, it is beginning to take a prominent place in the field of quackery, with plausible and high-sounding pretensions, and in such a way as will probably prove an obstacle to its employment in legitimate medicine. I do not think, however, that legitimate medicine will suffer much by the loss, for, whatsoever may be the influence that Electricity has on the functions of the human body—and it is undoubtedly great,—this influence or these influences can best be brought into action through the judicious use of the old and ordinary means, whether pharmaceutic or psychologic, which the profession has long been accustomed to employ.

I do not, therefore, intend to treat the subject specially in its medical aspect, and shall, without further apology, bring it before you in the way that has happened to approve itself to me. You will not, I hope, take offence, if I ask you, during the reading of the Paper, to fancy yourselves in the position of a group of children, or of unsophisticated natives of the East, listening to one of their own story-tellers while he tries to please them for an hour, and to convey to them some practical and useful instruction by the scenes and sketches he places before their imagination.

When the Allwise, Omnipotent, and Eternal created and organised this world, He placed in it certain Genii, immortal but soulless spirits,—His slaves, or ministers, as they might be called, to carry out His will in its government, and in the purposes He had in view in its creation. One of the most powerful of these—the Geni of the (secret) fire, Electron—is invisible to the human eye, and unrecognisable by the ordinary human senses, except upon rare occasions, or when subjected to the spell of a skilled magician.

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* Read at the Medico-Chirurgical Society of Aberdeen, July 5, 1883.

It is difficult to give the correct portraiture and dimensions of this great spirit, but it may be said that, while his head reaches far above the clouds, and his feet go down into the bowels of the earth, and traverse them more freely than a bird can fly through the air, he can also enter into the smallest and invisible cell that forms part of the material of the globe. In truth, he performs an important part in almost all the operations going on in the world, whether great or small, but so quietly and gently does he work, that his presence is never known or suspected, except on the occurrence of something calculated to rouse him to anger or opposition.

The power and immensity of this Geni may be in some degree comprehended when it is stated that the tremendous roar of his voice, the dazzling brightness of the flash of his eye, the inconceivable rapidity of his movements, and the irresistible force of his strength, are such that in respect to them there is no terrestrial being that can for a moment be compared with him. When careering with his full force, if any obstacle should interrupt his progress or tend to circumscribe his liberty, he will in a moment burst the strongest barriers in his way, shattering and destroying them by streams of fire, which he launches forth, accompanied with such appalling and tremendous bellowings as seem to make the earth to tremble. Such behaviour (comportment) on his part naturally inspires mankind with terror and awe, and it has had the effect, in past times, of deterring them from cultivating his acquaintance or friendship. Indeed, until very recent times, they looked upon him more in the light of God's minister of punishment and destruction than as the friendly and beneficent, though powerful, being they are now beginning to discover him to be.

A wise man of America, named Benjamin, who, more than a hundred years ago, was among the first who had the courage, sagacity, and tact to enter into close and friendly relations with him, by a careful study of his character and habits, succeeded in making an arrangement by which, in consideration of an easy and free passage being provided for him to his favourite resting place under the ground, he gave promise for the future to refrain from an old and destructive practice he had been in the habit of indulging in,—that of toppling over and destroying towers, chimneys, and other lofty buildings that chanced to attract his notice. And the fact of his having honourably kept this promise has led to a further study of his powers and peculiarities, and to the cultivation of more friendly relations with him than had been done before.

He is constantly hovering and brooding over the earth, mantling and pillowing himself in the clouds, sometimes marshalling them in hostile array, and furnishing them with artillery against each other; travelling with them in their movements, and descending with them in the form of rain to refresh and fructify the ground; ascending, also, as well as decending, by secret and imperceptible movements, in the performance of the innumerable services which God has ordained him to perform. Though such is the usual and gentle manner of his transition between earth and sky, yet it sometimes happens, when he finds himself unduly confined on the one side, that he will make a sudden and irresistible bound to the other, overturning, blasting, and destroying whatever stands in his way, and emitting a roar of thunder, surpassing in awe-inspiring grandeur the cries of all the wild beasts of the forest blended together.

By following in the wake of the American *savant*, electricians have succeeded in greatly mitigating—in many instances, in entirely averting—the calamitous effects of such occurrences. Knowing the partiality he has for certain of the family of the metals, and the willingness with which he will accept of their guidance and means of transport, they have constructed roads (literally rods) of iron or copper between the earth and the highest points of the chimneys and lofty buildings that were wont to be injured by him. These rods are pointed, and often trifurcate, at the upper extremity, so that the Geni is more easily arrested and attracted by them; and when induced to enter, he is gradually but quickly led down to the earth till all danger of a sudden outburst is past.

For many ages mankind were almost unaware of the presence among them of this powerful spirit, nor did they know that he was unceasingly employed in their service; and much less were they able to summon him at will to appear visibly and tangibly, and to exhibit to them some of his wonderful powers. When at last they *did* succeed in this, the utmost wonder and interest were excited by the display, although the form it took was what might at present be looked upon as mere childish tricks compared with the stupendous and beneficent powers of which he is now proved to be possessed. His favourite resting place of retirement is, as I have said, deep in the interior of the world, from which, however, he is continually emerging, and gliding to and fro through the earth and the air, doing an infinite variety of useful and beneficent work; after accomplishing which he, by the law of his existence, quietly retires to his place of concealment. But if anything should stand in his way or resist his passage, woe be to that person or thing. Personal injury, or even destruction or death, is sure to be the result.

Notwithstanding the amount of work he is known to perform, Electron is also fond of dancing, and his favourite place for enjoying this pastime is in the neighbourhood of and around the poles of the earth. There, in a bright frosty evening, mortals may often get glimpses of his holiday garments corruscating in all the beautiful hues of the rainbow, mysteriously vanishing and re-appearing as he disports himself in the fantastic evolutions of his mystic dance.

He exerts a mysterious but powerful influence on the sensations of living creatures. The behaviour of many of the lower animals gives well-understood indications and warnings of changes of weather to be expected from his approach. In the human body he can, by his presence, induce either the most pleasurable and salubrious feelings, or sensations of the most disagreeable and unbearable nature.

There were various ways in which the Magi at first succeeded in conjuring this potent spirit and making him give indications of his presence. Sometimes this was done by making a grateful and rapid friction with a metallic or other substance of which he is known to be fond, through the medium of a suitable receptacle placed in communication, or *en rapport*, with the earth where he resides. The result is that he comes gradually into the vessel (or trap), and indicates his presence by a crackling noise and the emission of sparks, just as is done when the back of a cat is treated in a similar manner. At other times he was tempted by a dish of metals stewed in an acid, for which he has a predilection.

But now, by God's permission, the power has been given to the wise men of various countries, more especially those of Britain, France, Germany, Italy, Russia, and America, to secure, bind, and imprison him in a leaden vessel or casket, and to seal it with the seal of Solomon the Wise, so that he can be kept there as the submissive slave of his captor, carried to a distance, and when released, forced to perform whatever work may be appointed him to do. In this way he can, under proper superintendence, be made to perform the work of a domestic slave or servant, in sewing, washing, &c., and even in lying on the watch and sounding an alarm in the event of robbery or fire. He can also be made use of as the motive power of vehicles and machinery of all kinds. In short he can be made to perform any kind of mechanical labour which does not require the direct exertion of mind and intelligence—gifts which God has bestowed on man alone.

The motions which God has given to the great oblate globe of the earth must, we should expect, cause relative motions on the part of such a mobile and ethereal substance (if substance it can be called) as that of this great Geni. We do not know the natural laws by which spirits are governed, but, speculating on their analogy to those which apply to the rarest of fluids and gases that we are acquainted with, we may to some extent be assisted to understand how much a spirit would comport itself in the world, though even the laws of acoustics or of hydrodynamics cannot properly be considered as applicable to so immaterial and imponderable a spirit as Electron. The natural effect produced on these fluids by the rotation of the earth would be centrifugal at the meridional circumference, and centripetal at the poles. In the case of the electric spirit (supposing, as some think, that it *has* the slightest amount of gravity), the rotary motion of the earth would, at both ends of its axis, tend to draw it into the interior, which it would penetrate and traverse as easily as if it were a hollow sphere; and, the motion of the globe being greatest at its equatorial circumference, the spirit would find his way there, and would (thence) issue forth refreshed and invigorated by his passage through the central fire of the earth, imparting warmth and fertility to the tropical regions, though often giving indications of his superabundant presence by frolicsome outbursts, which are sometimes attended with disastrous consequences. And thence he would become diffused through and over the atmosphere, and so would find his way back to the Poles, there to be again absorbed, and to enter again on what may be called his normal circuit of the earth. Thus the earth sustains the part of a vast storehouse, continually receiving detachments from this spirit of the universe by its great polar and other entrances, and continually giving forth supplies by even more numberless exits.

Though one of the principal agents in carrying out the laws by which God governs the world, Electron is himself subject only to such laws as are adapted for his constitution and the purposes for which he was created. Though the chief factor in all the attractive forces, from gravitation itself down to the minutest molecular or chemical attraction, he is himself in a great measure superior to and unaffected by any such compulsion. The daily rotation of the earth—at the rate of 17 miles per minute at the equator—will not carry him along with it. Being, like other spirits, destitute, or all but destitute, of gravity, he is not involved in or carried away by the motions of the earth, except in so far as he is functionally attached to it, and to that amount he must necessarily accompany it. But yet he has movements through the world of many kinds, in accordance with laws, some of which are known and others are still undiscovered.

This powerful and ubiquitous Geni has close relations with all animate and inanimate things in the world. Between him and some of them there is a much greater attachment than with others, as, for instance, in the case of the metal iron, that greatest friend and servant of man of all the metallic race.

The farther our researches and observations have yet been carried (in this direction), the more they tend to confirm the belief, inspired also by the study of other branches of natural science, that the Almighty wisdom and power operate by means at once the most uniform and simple in their individual and atomic manifestations, and unspeakably efficient, grand, and beautiful in their combined and predestinated outcome. The universe consists of an infinite number of globes or spheres in constant, regular, and multiplex motion, and having certain sympathetic influences and relations with each other through means of a property called gravitation.

The ultimate or minutest conceivable division of matter, as well as the careful study of its properties, lead to the same conclusion as to *its* constitution, namely, that its atoms or ultimate components are also spheres, either in motion or capable of being put in motion, and having opposite poles, and attractive powers for other atoms, whether of the same or of different species. But, instead of being called gravitation, the attractive force of these atoms is known as chemical action, though it is believed by *savants* to be the effect of some special properties conferred upon them by Electron. And it is—beyond all his other qualities—by his power of imparting and governing these molecular attractive forces, that such all-important results are produced throughout the world as prove the Geni, Electron, to be the most powerful and omnipresent of God's ministers on earth. When the particles of different kinds of matter are free to mingle with each other, which, by means of heat, air, water, and other media, they can be made to do, he can make them change their arrangements, and subject them to such magical transformations as to become entirely new substances with appearance and qualities essentially different from their previous condition. That *he* is the immediate agent effecting this may be fairly inferred from the analogous work he is known to do on a larger and visible scale, as well as on other reliable scientific grounds.

We can easily see the results and accompaniments of this great spirit's working, in many of the phenomena of the world, but no man has ever yet seen him *actually* at work, or discovered his precise *modus operandi*. When God made himself known to Elijah, it was not in the tempest, the earthquake, or the fire, but in the still small voice in the desert. And so it is that the silent and secluded chamber of the scientist is also the most congenial and favoured place for contemplating the working of his great minister on the earth. By long-continued transformations of the kind described, he has changed, and is still changing, the aspect and condition of the surface of the world. And it is by a knowledge of these powers, and the wisdom to take advantage of them, that most important results, both to the initiated scientists and to the world in general, can be obtained. Out of three or four elementary substances, for instance, he can, under propitious circumstances, form a vast number of things of very diverse qualities, adapted to enrich, sustain, and beautify the world and its inhabitants. Like a skilful general or a clever master of ceremonies, he can place his subjects (small and invisible to us as they are), in all manner of composite groups, and in every variety of arrangement ; and by his signal of command can make innumerable hosts of them embrace and coalesce so as to constitute new masses possessed of a character and qualities very different from those they had before, as well as from those of other groups composed of the same elements.

Individuals previously harmless or benign he will sometimes combine together so as to form a band of poisonous murderers. Awkward and spiritless dolts he can associate, pair, and arrange together in such a way as to develop in them high-spirited and estimable qualities. By selecting, drilling, and arranging a parcel of the most worthless and unattractive of things, he can turn out some of the most beautiful, useful, and valuable combinations that have in these times enriched the world. But besides the changes in regard to qualities easily recognised by our senses, such as colour, taste, and smell, there are many other and more subtle changes which he effects that are not so readily appreciated by us.

The true *rationale* of these changes is, I suspect, almost entirely beyond our comprehension. With regard to colour, knowing as we do that Electron, if not identical with light, is even superior to and inclusive of it, and of course comprehends in his essence all the elementary colours of which white light is composed, we may more readily understand the powers he has in this department. It is quite conceivable that the ultimate atoms and the molecules of matter may have special affinities for certain of these colour-elements, as we know they have for the other spectroscopic elements of light, and that they will, in consequence, reflect some, but absorb or neutralise others, appearing in that colour which they reflect, and showing black if they absorb all, but white if they reflect them all.

So subtle and all-embracing is the essence of this great spirit that there is no part of the world, and of whatsoever it contains, that is not more or less imbued with it. But though embracing all things, he shows a decided preference for some above others, and this in so manifest a way that the Magi who are devoted to his service have had no difficulty in making out a catalogue of things in the order of his predilection for them. Among those for which he shows the highest favour and attachment are the great family of the metals, and it is chiefly through their means that mankind have been enabled to become acquainted with his character and qualities, and with at least some of the laws by which he is governed in the work which God has ordained him to do. By their means it is, too, that his extraordinary powers and qualities are being more and more applied to the direct service and benefit of mankind. While an iron railway will convey its human travellers at the rate of a mile per minute, one at a fraction of its price can convey this Geni many thousands of miles in the same space of time.

By operating through means of the different degrees of mutual affection between these atoms and their chief, and for each other, he can bring about a sharp and speedy conflict among them, leading to their separation and re-arrangement, so as to form entirely new groups, with characters and powers very different from those belonging to the previous groups, or to the individuals composing them.

When Electron is made closely to embrace and to pass repeatedly round a portion of his favourite metal, it becomes magnetic,—that is to say, so imbued with his spirit as to have the power of attracting to itself, and holding firmly, portions of the same metal equal or even greater in weight than itself. A variety, too, of this metal, named loadstone, is to be found in various parts of the world, which has the same quality, with the addition of being able—by close contact and repeated embraces—to communicate it permanently to other members of the ferric family. And in connection with these latter an important passage in the history of Electron has now to be mentioned.

These magnets, as they are called, have a tendency to arrange themselves, and when allowed perfect freedom of motion do arrange themselves, in a line parallel, or almost parallel, to the axis of the earth, one of their ends or poles always pointing to the northern and the other to the southern pole of the earth,—a wonderful property which is taken advantage of (and has been for many centuries) in the form of the mariner's compass, for the safe guidance of ships across the pathless ocean. But less than one century ago a Danish *savant*, named Oersted, discovered another singular peculiarity of these magnetic imps, namely, that the instant they find themselves in the immediate presence of Electron they make a reverential sign of obeisance to him, which he doubtless (in some way to us invisible) acknowledges. If he approach them in front they turn to him by a movement to the right; if he approach them from behind they face round to him by the left, always retaining their position across or at right angles to his path, during the presence of their great chief.

Little did Oersted foresee the important uses afterwards to be made of the little odd peculiarity he had discovered; but succeeding wise men who have given themselves to the service of Electron, by taking advantage of this devoted attachment of these small magnets, have devised a way by which persons living at the greatest distance from each other can hold almost immediate correspondence. And this is the way in which this God-like achievement can be accomplished:—A copper or iron wire is laid either above or under the ground, or along the bottom of the sea, of any length from a few yards to thousands of miles, and the Geni, being exorcised *secundum artem* from his place of concealment, can be sent by qualified assistants or operators along this friendly path to the place intended, where he is made to pass across one or more of the magnetic imps, who instantly give him the quasi-military salute just described. These transmissions and salutes can be repeated so rapidly, and timed and grouped together in such a way, that a code of signals can be formed by them that shall be equivalent to ordinary language and be easily transferred into it by those in charge, at either end of the wire of communication, and so rapidly can he do his work that three or four clocks at either end can be giving and receiving messages at the same instant of time. Electron can even write out messages as fast as they are sent, when he is supplied with necessary materials and suitable apparatus for the purpose.

But what is still more wonderful and demonstrative of the power and wisdom of the Master whom he serves, this Geni can send his voice, in an audible and intelligible form, to a distance of hundreds—or even thousands—of miles. And this is the way in which this lately discovered power of his can be applied to the service of mankind. An imp belonging to the ferric, or some of the other tribes for which Electron has a partiality, is selected, of a thin, delicate, and highly sensitive structure, and is placed in a position where the Geni can have free access and contact with him. A person wishing to speak with a friend in a distant part of the world has only to address his words at a short distance to this imp, whose sensitive body is immediately made to vibrate in harmony with the sound-waves of his voice. These delicate and invisible vibrations are recognised and received by the Geni where he lies enveloping the atoms of the imp, and are by him carried to the other end of the line of transit, where they are repeated by him in the body of another imp similarly placed in regard to the conducting medium, with the result of causing corresponding vibrations of the air, so as to reproduce sounds and words exactly corresponding to those emitted by the speaker at the distant station, so that his listening friend can hear them instantly, and exactly as they were pronounced.

Intelligence so transmitted, by either of these methods, can be quickly communicated by messenger to the person for whom it is intended, or to the public by means of the newspaper and the post; and thus the spirit Electron may be said to supply the part of a nervous system to the world, keeping all its parts in immediate sympathy with each other, and enabling them to act in harmony for the general advantage.

The sensitive and delicate perceptions and touch of women are found to be peculiarly adapted for these manipulations; and it must be gratifying to the advocates of women's rights to find that a new field has thus been opened up for their employment which is at once scientific, congenial, and remunerative. In one room alone at the London Post-Office there are a thousand female clerks, whose active brains and fingers are constantly at work; and from this instance we may judge of the vast army of women employed in the service of Electron throughout the world.

The movements of a spirit such as Electron are essentially of a different nature from those of material things which are acted upon by the laws of gravitation, and of other forces which are readily recognised by our senses, and which can be intelligibly comprehended, measured, and practically formulated. Spirits, being destitute of weight, cannot, unless in a slight and indirect way, be influenced by gravitation. Their inconceivably rapid motion is entirely unlike that of gravitation, being more of the nature of mental emotion, or of vibration, than of a bodily change of place. The electric spirit, in so far as it enters into the constitution of material things, and functionally permeates or envelopes them, will accompany the world in all its movements; but in other respects it will not accompany it, or participate either in its rotation or its orbital motion.

It will thus be understood that the Earth in its diurnal motion brushes through and athwart the portion of this spirit that lies nearest to it at the rate of 17 miles per minute at the Equator, and at a gradually diminishing rate towards the Poles. Or, it comes to the same thing to say that the Geni traverses the surface of the Earth at this rate along the parallels of latitude from west to east. One result of this is that the whole army of magnetic imps throughout the world, that have from their size and constitution the requisite freedom of movement, must continually assume the rectangular or military position towards their great chief. In other words, they will point in the direction of the terrestrial poles,—a permanent and invaluable phenomenon, which, in the guise of the mariner's compass, constitutes one of the greatest blessings to mankind.

As a curious presumptive corroboration of the truth of this idea, a well-known experiment may be called to remembrance:—If a rod of soft iron be suspended at right angles to the electric or magnetic current,—that is to say, nearly north and south, with a considerable dip to the north,—and smartly struck several times, so as to put its particles into a state of vibration, these particles will assume the deferential or military attitude, and retain it *permanently*, along with the magnetic power which it confers, thus converting the rod into a magnet.

This powerful Geni does not disdain to act the part of a most useful and obedient servant or slave. Without his spontaneous assistance as the fermentative agent, the processes of baking and brewing could not be successfully carried on; and by a little skilful management he can be made to work sewing and other domestic machines, to ring bells of warning at any distance that may be required,—to transmit messages to any distance with accuracy, and with a promptitude that no human messenger could equal,—to act the part of a watchman, and give instant warning of the approach of burglars or thieves; he can give warning of the escape and anticipate the movements of criminals, so as to lead to their apprehension, and thus prove himself a powerful aid to law and to good government. He will even detect the first outbreak of fire, and give timely warning of it. He transmits true time, and keeps our clocks in harmony in all parts of the kingdom. He gilds and plates our spoons and metallic goods; he reproduces our medals and works of art in metal, including the most valuable artistic engraving plates. He can, at a safe distance, detonate the charges used in quarrying and mining, and can explode submarine torpedoes and other explosive contrivances, whether used for warlike or peaceful purposes.

These are only a few of the numberless benefits for which we are indebted to Electron. But there is one department, of public and domestic importance, where his services are available, and where they are destined—probably at no distant date—to contribute in a high degree to the welfare and the happiness of the world. He can be made to assume the character of an angel of light, or, as some might prefer to say, of the demon Lucifer. But in whichever of these aspects you may choose to regard him, it is quite true that he can be made to give out light in almost any amount, and of a beauty and quality, and freedom from noxious effluvia, surpassing any artificial light that has yet been attained.

There are various ways in which the Magi and their operative assistants have been able to effect this transformation, but the usual and the most efficient is by making use of the intervention of another Geni whom scientists have much more completely under their command. This spirit, though belonging to a much lower order of created beings, has within the last hundred years been found to possess capacities—and has had them practically employed—for the promotion of the power, civilisation, and happiness of mankind, to an extent that is apt to deceive the ignorant into a belief that he is equal, if not superior, to Electron himself. He may be described as a hybrid, generated by the impregnation of water by Electron, and is invisible like his father, but, like other beings of terrestrial or semi-terrestrial origin, is short-lived, and continually tending to return to the form and substance of his mother. He is the most extensively known and powerful of a large tribe of similar spirits, the result of the intrigues of Electron with nymphs of terrestrial lineage, and he derives his energy and strength from his father, and his pliancy and instability from his mother.

Vaporin, as he may be designated, can, by the connivance of men, be generated within strong, iron, closed vessels; and by the continual and powerful efforts which he makes to escape, and through means of the strength he puts forth while making his escape, he can be made to do almost any amount of mechanical work through the intervention of ingenious and appropriate appliances. Well, this Vaporin Geni can be made to rouse the nobler spirit of his father into violent excitement by driving to and fro across his path a number of electro-magnets at the rate of two or three hundred times in a minute, and thus compelling him, in accordance with a law which is binding upon him, continually to come into the path most accessible, and respond to the salaams made to him by the electro-magnets. In this pathway there is, too, placed a break or interruption to his progress, in the form of some material to which he has an antipathy, or at all events does not take very kindly to, and at the point of crossing this unpleasant obstruction he flashes forth such a glare and blaze of light as can be exceeded only by that of the sun himself. In this magical production of light the part contributed by Vaporin is merely that of a mechanical slave, which could be performed almost as well by the force of gravitation, by wind or water power, or by the muscular strength of the lower animals.

Though it has suited the drift of this paper to view Electron as a spirit specially belonging to the Earth, where we can most readily perceive and understand his agency, there can be no doubt that he extends throughout, and fills the universe itself, or at all events that he is co-extensive, as well as coincident, with light itself, which we know reaches us from the most inconceivable depths of space. But if we can only speculate in regard to most of his operations here, how little can we know, or even conceive, of the entire purposes for which he is employed by the Almighty Architect!

Whatever may be thought of the marvellous and beneficent powers of this great Geni, as I have attempted to describe them, in reference to the *Cosmos*, there is a department of the work assigned to him by his Creator which is to us as important, if not even more inexplicably wonderful. I allude to the services he performs in regard to the *Microcosmos*, and in the development and the vital action of all living creatures, bearing, as these of course do, upon the physiological and medical aspects of Anthropology. On some of the mysteries of these subjects it is probable that there will fall in time a share of the light which his scientific cultivation is now throwing on other subjects of human interest and utility. Into this department I shall not, then, attempt to enter. The superficial and general sketch just attempted is indeed quite sufficient for the limits of an ordinary communication.

The form of allegory, or slightly interrupted allegory, in which it is cast, is, of course, not like a scientific or logical and deductive treatise. It is, and professes to be, nothing more than a semi-fabulous and romantic account of the matter of which it treats. By a wave of its magic wand it sweeps away doubts and difficulties, and fills up gaps or dangerous and defective paths which stand in its way. As Browning says—

> " It brings the invisible into play,
> By letting the visible go to the dogs."

By an instinctive stroke of the imagination it fills in whatever is wanting to render its narrative as life-like, truth-like, and acceptable as possible ; and yet it is quite possible that it may convey the elements of truth as really as many a dry and laborious philosophic dissertation. By the quaint and grotesque points of view in which it presents the subject, it tends to bring out new features and aspects of it which might be overlooked in the ordinary light of scientific treatment.

By personifying a subject like the present we are led to take a kind of personal and familiar interest in it, and to enter into many of the bearings it has on our daily life and well-being, which would be overlooked if it were treated purely as an abstract scientific theme.

And there is another point of view in which some might be disposed to regard it favourably. If not in accordance with the most recent views in Theology, it is at least in harmony with the older and orthodox idea of the personality of God. It strikes the same key-note of impersonation, and is in accordance with the style of language employed in the Bible, and with the way in which an old Hebrew prophet might have declaimed on such a subject. Nor is it out of harmony with the mode of expression still made use of, and still most readily understood, by the great mass of mankind, regarding His operations in the world.

V. ON SANITARY REFORM.

By Rev. S. Barber.

We may regard the question of Public Sanitation as affected by the efforts of the people for their own benefit, or by the influence of local authority, and the perfecting of the machinery of the central government. There can be no doubt as to the utility of instructing the people in the laws of health, while the ascertaining of the best method of government depends partly upon experiment. But if we were disposed to apply an exhaustive and rigorous analysis to determine the *fons et origo malorum* of unhealthy conditions, we might, perhaps, arrive at the simple conclusion that these may be summed up in the single word "selfishness." But this would be proving too much, like the ingenious etymologist who reduced all the radicals of a language to a single letter. The forms of selfishness, indeed, are marvellously varied, both in character and degree. The collier or brick-setter who neglects his own household, and outrages the *laws of health* in his humble dwelling, is certainly blameworthy, but the apathy and selfishness of a chairman of trustees, or a medical officer of health, is a matter of much more serious import to society, and more culpable in itself.

Let us take for granted that all the intelligent inhabitants of any ordinary town, not excepting the (*so-called*) "*working* classes," or at least a majority of these, are in favour of *real* sanitary improvements. The desire of self-preservation, taken in the aggregate, necessitates the existence of this feeling in society. It is now quite needless for the members of health committees to pour forth impassioned orations upon the general question of sanitation. It is the management, the details of a scheme, the workmanship, and the financing which chiefly concern the ratepayer.

It is now some time since the English people became impressed with the feeling that it is better economy to expend public money upon elementary education than upon the maintenance of criminals undergoing imprisonment. Thus the public education has long since passed the experimental stage, and it is no longer an open question as to the public duty of providing a modicum of mental training *for the whole population.* He would be a bold man who should stake his popularity by pandering to the prejudice of a still existing minority, in advocating a policy of retrogression. But though the machinery of elementary education is now regarded as an established and inevitable fact, there remains still a vast field open for educators, theoretical and practical, in the discussion of details and the application of statistical analysis.

But in the case of sanitary improvements, or rather in the reduction of our social arrangements to the demands of sanitary law, this stage of public feeling has not yet been reached. The desire for improvement exists, but the public are not yet instructed in the principles of public health. Too many among us—not only average ratepayers, but guardians, teachers, magistrates, and medical officers—regard the appliances and regulations of sanitary science as having their sole *raison d'être* in abnormal and extraordinary social conditions. By such persons these things are not looked upon as essential to healthy life. Thus we find that sudden and ill-advised attempts at sewerage, insufficient water-schemes, and the like, often take their origin from some panic which has seized upon the public mind, or from the effects of an epidemic. Work thus initiated cannot, of course, be so complete or so successfully applied to effect the desired end as that which is deliberately undertaken in the "quietness of thought," and as matter of *principle* always binding upon society. What should we think of the captain who had his vessel put in trim for fair weather, and then set off to sea on the assumption that fair weather would continue throughout the voyage? Yet this has been too much the method of procedure adopted by those who have had the care of public health placed in their hands. And any man who proposes the arrangement and construction of a town upon true sanitary law will for a long time be regarded as a dreamer and an enthusiast.

VI. DO SNAKES SWALLOW THEIR YOUNG?

By JAMES SIMSON.

IT will doubtless interest the readers of the "Journal of Science" to learn of the origin of the paper on the question "Do Snakes swallow their Young?" which was read before the American Association for the Advancement of Science, in August, 1873, by Prof. G. Brown Goode, and substantially copied by Miss Hopley in her book on Snakes. In "Land and Water" of December 7th, 1872, and January 11th, 1873, I had two letters on the subject, which made, in "Contributions to Natural History," ten large double-column pages of small type, closely printed,—a great deal more matter than is to be found in Mr. Goode's paper. In the last of these letters I said:—

"All over America young people are often killing snakes, some of them pregnant with young and some with eggs, and sometimes the same species pregnant with both, but not, of course, at the same time, which, as well as swallowing of the young, cause them no small astonishment; and there the matter rests. But older and more intelligent people understand the phenomenon of the animal laying eggs to be hatched in the soil, and then taking the young inside of her for their protection; and they often express their surprise that this peculiarity of the serpent tribe is not described, or hardly recorded, in the pages of natural history."—(P. 16.)

At the very beginning of my first letter I said:—

"Has anyone, in dissecting a female viper, found *eggs* within her? and has anyone found *young ones* inside of another? If both have been found, then, as a matter of course, the reptile must have swallowed her progeny."—(P. 7.)

Mr. Goode read these letters in "Land and Water," and immediately afterwards (on February 1st) inserted a notice in the "American Agriculturist," having a large circulation in the United States, soliciting information on the subject of snakes swallowing their young. I sent slips of my two letters that had appeared in "Land and Water" to the editor, with the remark that I was rather averse to doing it unless I knew the person wishing the information, and the use he intended putting it to. Some time afterwards I had a call from Mr. Goode. On January 11th, 1873, I sent a letter to "Land and Water" (printed on July 19th), in which I said:—

"In the event of the present papers finding their way back to America, and being so brought before the notice of the public as to really interest it, I am satisfied that more could be collected from intelligent people in or from country places than one would perhaps care to be troubled with."—(P. 17.)

In regard to his advertisement Mr. Goode said:—

"As a result, over eighty letters were received from persons in twenty-four States and Provinces, almost every one containing valuable evidence. Many of the writers seem indignant that a fact so well known to them should be questioned."—(P. 5.)

These answers confirmed, in every respect, all of what I had published in "Land and Water" previous to February 1st, 1873, and after that till the last of them, which was dated June 26th, as well as two very important letters, to be found in "Contributions," pp. 23 and 25 (sent to, but not printed in, "Land and Water").

On July 23rd I wrote "Land and Water," with a letter of the 21st from Mr. Goode to me, in which he gave the result of his advertisement, and said that he intended reading a paper before the American Association, and asked if he might use my name, if necessary, in connection with the subject (p. 36).

On September 10th I sent "Land and Water" Mr. Goode's paper, read before the Convention, as taken from the "New York Tribune" of August 27th, in advance of the official copy, which was printed in April, 1874, making a page of "Contributions," with a page of comments (pp. 36 to 38). All that I have mentioned appeared in "Contributions," published in Edinburgh and London in 1875. This work was very little noticed. The late "Dublin University Magazine" for July, 1875, said;—

"It is a vexed question whether, under any circumstance, the young retreat into the stomach (inside) of the mother snake. A great authority (?), Mr. Frank Buckland, affirms that they do not, while our author is as positive that they do. And he certainly, with reason, contends that the question is entirely one of evidence, and therefore should be settled 'as a fact is proved in a court of justice; difficulties, suppositions, or theories not being allowed to form part of the testimony.' . . . In support of his own views, Mr. Simson has collected a large body of evidence that undoubtedly appears authentic and conclusive."

On the same occasion "Land and Water" noticed the work as follows:—

"The fact that the natural-history papers in this volume made their appearance in the first instance in these columns is an effectual bar to our offering any opinion on their merits."

To this I replied that "All of the natural-history papers were sent to this journal, but only about half of them, as the work plainly shows, were published in it, and these did not include the most important on the viper question: they were all intended for Mr. Buckland, in his usual manner, to comment on them, and admit or reject the evidence contained in them."—(P. 193.)

It was in October, 1873, I learned that Mr. Buckland was an "anti-swallower.' Notwithstanding the evidence furnished in "Contributions," Mr. Buckland published, in his edition of White's "Natural History of Selborne," some strange remarks on this subject; and still stranger ones in what he afterwards wrote in "Land and Water" of September 2nd, 1876, when he gave a woodcut and a description of "a viper supposed to have swallowed its young." This forced me to review Mr. Buckland very fully, which I did in an Appendix (pp. 187 to 199) in 1878, that made part of the issue of "Contributions" in 1880. I there said that he was "a bar in the way, the cause of unnecessary trouble, in having the question of the viper swallowing her young admitted as a fact in natural history."—(P. 197.)

In my two letters, read by Mr. Goode before he took up the subject, I said that "various kinds of snakes," and "all the American snakes as far as known," swallow their young. The letter procured by him gave the names of many of these, and, as I have said, confirmed everything I had written in my two letters, which contained all the facts and principles connected with the subject, and illustrated what I wrote in mine that appeared in "Land and Water" on January 11th, 1873:—

"A state of ignorance in regard to the serpent tribe cannot be said to exist in America, although the knowledge possessed by people is of a casual and partial nature, more or less recent and rusty, and disconnected from any theory or system, which makes it all the more reliable to a person who will gather it up, like pieces of a puzzle lying loosely around, and arrange it into a whole."—(P. 17.)

There is not an attempt at generalisation in the letter received by Mr. Goode (as printed), while all of mine (particularly the first two) were full of it, and which he might have availed himself of. Even in the remarks (which could not be called a discussion) at the Convention there is much error, especially when allusion is made to young snakes being found in the *throat* or *stomach* of the mother, and to the *gastric juice* of the old one; for in my first letter I said that the—

"Eggs were in a chamber of much greater height and width than was necessary to hold them,—something apparently distinct from the stomach proper,—and doubtless the receptacle for the young after being hatched outside, and which could be greatly expanded, according to the nature of snakes."—(P. 10.)

And in my second letter, in regard to the viper, I said:—

"If it can be demonstrated that she is even *semi*-oviparous, in the proper sense of the word, then it necessarily follows that she is a 'swallower,' since she is found with young inside of her."—(P. 16.)

And in my comments on Mr. Goode's paper I said:—

"As in mathematics we require to know some things to demonstrate others, so in snakes swallowing their young it is not necessary for a man of science, or common sense, if he will but exercise it, to see it done in order to believe it; but when ocular testimony is added it sets the question at rest beyond all doubt."—(P. 38.)

On this head I wrote, in the Introduction to "Contributions,"—

"Intelligent and ingenious people generally prefer to see an idea started and elucidated, with all the circumstances attending it—as some enjoy the breaking away of a fox, and being well up with the hounds, and in at the death—rather than have the dry result of an inquiry stated to them; for then they become, as it were, investigators along with him who makes it, while the particulars give them detailed and positive evidence of the conclusions arrived at."—(P. 3.)

White, in his "Natural History of Selborne," wrote as follows:—

"It is no small undertaking for a man, unsupported and alone, to begin a natural history from his own autopsia. Though there is endless room for observation in the field of Nature, which is boundless, yet investigation (where a man endeavours to be sure of his facts) can make but slow progress; and all that one could collect in many years would go into a very narrow compass."

As a comment on this I said:—

"As a general thing, a knowledge of the habits of snakes, more than perhaps any other animal, can be acquired only by a person collecting the experience of others, and comparing it with his own; one having observed one thing, and another another."—(P. 16.)

And when reviewing Charles Waterton I said:—

"In investigating what White calls a 'province' in natural history, especially in a strange place or foreign country, it is necessary at first to make inquiry in every available quarter, and test the information by personal examination; or carefully question various intelligent witnesses of character, and perhaps devoid of preconceived opinions or theories, as to what they have seen, to ascertain the reliability or the apparent correctness of what is advanced, and give it as such. It is observation, conversation, reading, and reflection that make the naturalist; but principally observation, and passing the rest of his information through his mind to make it his own. Waterton doubtless made use in some form of the information of others, although he did not acknowledge it. How did he acquire even the common names of animals unless he derived them in some way from his fellow-creatures?"—(P. 38.)

What I have written has no reference to Mr. Goode, with whom I had every reason to be pleased. The "British Quarterly" for April had good cause to feel "surprised" on finding that Miss Hopley had made no reference to my work, "the more especially that she seems to have read everything on the subject," and that I supplied "a good deal that she was in need of as evidence." The fact is she has suppressed everything I wrote on the subject, after having read "Contributions" (as she has admitted), and used the book to find the Report of the American Convention, given, as I have said, at pp. 36 to 38, with my comments to supplement its deficiencies. For this reason Chapter XXVII., on "Do Snakes afford a Refuge to their Young?" is not "up to the times," for it does not contain the *real* evidence on the question. Miss Hopley doubtless read all my letters (six in number) in "Land and Water," and noticed that Mr. Goode specially mentioned me twice in his paper; yet she quotes the very short remarks of a dozen others mentioned in it, in which, as I have said, "there is much error," while she has passed over my information published in "Land and Water," which made twenty-two large double-column pages of the book, and ten pages which did not appear in that journal, although sent to it. In fact all that I have written about the origin of Mr. Goode's paper appears plainly in "Contributions," except that of sending the printed slips from "Land and Water" to the editor mentioned, and afterwards receiving a courteous call from Mr. Goode.

Miss Hopley, at the end of Chapter XXVII., says:—

"In concluding this speculative chapter I can only humbly beg to 'second the motion' put to the learned assembly at Portland, Maine, in 1873, to the effect that the subject will receive the attention of ophiologists in all the snake countries of the world."—(P. 506.)

In no sense did she *second* Mr. Goode, as we have seen. For had she done so, and drawn on my information, which she had before her, she would have shown that the question was no longer "speculative," but *mathematically certain*, that "snakes swallow their young." In her book she alludes to "a brood of young vipers lately born at the Zoological Gardens," and says that "the young viper comes into the world in the shape of an egg, and its first business is to push through the filmy membrane which envelopes it in its imprisoned form" (p. 433). I said that "vipers pass their young with a covering on them,—the original egg attenuated to the last degree,—which breaks as it leaves the mother, or immediately after it touches the ground" (p. 195), and asked how could we possibly find vipers nearly double the size of the new-born ones inside of a viper, unless they had entered it by the mouth,—as we find *oviparous* snakes "with young inside of them that were *hatched in the soil?*" I have never seen the subject presented in this form by any one I have read on it. Hence the unreasonableness of people saying "Bring me a viper with its mouth tied up, and all her young ones in her *throat* (!), and then I will believe you," as Miss Hopley says: the sceptics (p. 483) include the editor of the "Field," who, so lately as October, 1881, "closed his columns against investigation."

It would be interesting to hear how anyone knew as a fact that the eggs of vipers are hatched *inside;* about which I said, in "Land and Water," on January 11th, 1873:—

"It would be a curiosity in nature to find an animal that hatched an unlaid egg inside of itself: so great a curiosity is at once to be rejected, unless it could be supported by evidence."—(P. 12.)

New York, June 11, 1883.

ANALYSES OF BOOKS.

Walks in the Regions of Science and Faith,—a Series of Essays. By HARVEY GOODWIN, D.D., Lord Bishop of Carlisle. London: John Murray.

WE have here a work not easily dealt with from our especial point of view. On the one hand, it contains much of which we must decidedly approve, and much also which claims thoughtful and prolonged consideration. On the other hand, we find no little to which we must take exception, or which falls outside our legitimate cognizance. The author declares in his preface that "the volume is not a scientific treatise, nor yet what is called a religious book; it deals chiefly with questions which have both a scientific and a religious aspect, or, according to its figurative title, it contains the record of wanderings through that land which belongs exclusively neither to science nor to faith, but pertains more or less to both."

Here, already, there is scope for discussion. Many minds, fully recognising that Faith has a legitimate territory, into which Science has no right to intrude, will yet hold that "Faith begins where Science ends." Nay, if we do not misconstrue the author's meaning, he himself denies (Essay III., "God and Nature," p. 48) the existence of any such common ground. He writes there:—"We need a 'scientific frontier' between them, a line which shall on no account be transgressed by those who occupy the territory on one side or the other. The necessity of keeping this frontier line sacred is perhaps not sufficiently recognised." Again, the Bishop writes:—"The passage from one to the other is quite certain to be fraught with danger, not to say mischief." In fact, many an excursion into this supposed common region, from whichever side undertaken, is, like a Russian "scientific expedition," merely a disguised military *reconnaissance*.

The author, it will be observed, disclaims the right to "high position with respect to either science or theology." He adds, "the acquaintance which, as a Cambridge man, I possess with those branches of science which are susceptible of mathematical treatment, frequently leads me to view questions of controversy in a way different from that which might otherwise present itself, and at least impresses upon me very forcibly the necessity of not forgetting science while discussing theological questions."

That the Bishop is a mathematician is very evident. But, unfortunately, most of the essays in this volume deal with biological questions, where the author's special attainments seem chiefly to suggest far-fetched, and, we may venture to say, non-biological analogies,—of which hereafter. But whilst compelled to make this remark, we feel no less bound to record our conviction that he is actuated by no spirit of hostility, either to the results of modern science in particular, or to the great conquest of our age, the doctrine of Evolution in particular. True, he accepts that doctrine but in part. Yet, had he been from his childhood an observer and a student of organic nature, and had reached a truly biological point of view, we feel assured that these essays would have been seriously modified. In the funeral sermon which he pronounced in Westminster Abbey over the grave of Darwin, there would *not* have occurred these words :—"I, who have been invited to preach here this afternoon, have endeavoured to deal respectfully with his memory"!

Concerning the first of these essays on the "Connection between Mechanics and Geometry," we can say nothing. In the second, the author discusses the "Unity of Nature," taking as his starting point certain passages in the address delivered by Dr. Allman, at the Sheffield Meeting of the British Association, in 1879. He writes :—"The real difficulty of conception seems to me to be connected with the diversity of nature, supposed to rest upon one all-pervading principle. Grant protoplasm as the prime form of universal physical (organic) life; take that as the biological starting-point or prime postulate, and then comes the difficulty of conceiving the immensely different results in which our protoplasmic postulate land us." We must confess that we have never felt any such difficulty. But, to pass on to the main point of the present essay, we find the following question raised: "Is it not conceivable that there may be a principle or law from which the existing order of physical life, with all its apparent anomalies, flows as a necessary result? and would not the knowledge of that principle or law, if attainable, exhibit to us the order of living nature, as one consistent system, free from exceptions and anomalies?"

Before dealing with this interesting, but not truly solvable, question, let us first examine what is here meant by "exceptions and anomalies." Turning to subsequent pages (30 and 31) we find mention of, as anomalies, "noxious snakes, mischievous insects, &c." The author says :—"It is difficult for anyone who starts with the simple notion of the world existing for the sake of man to make out a consistent and tenable theory of nature." But the naturalist of the New School does not start with the "simple notion" above referred to, and hence the existence of snakes and the like is to him no more of an anomaly than the existence of man himself.

Again, the Bishop states that "the nipples and lacteal vessels of male animals, the rudimentary feet of certain snakes, the teeth of whales, and other useless organs of certain living things, may possibly be, like branches of a hyperbola, involved in the definition of the creature, inseparable from its existence, and yet forming no part of its active life."

Now, these useless organs are already accounted for in a satisfactory manner. Why, then, should we go forth in search of an explanation which has in its favour no tittle of evidence, save similes drawn from totally alien orders of facts? We admit that "the human mind can see the necessity of the existence of the useless branch of the hyperbola," but, we add, as a mere abstraction, not as a concrete reality. The author's mathematical necessities and possibilities exist at all time and in every place, but the organic world has changed and is constantly changing. Species have disappeared and are disappearing, either entirely or from certain parts of the world. How, then, can we pronounce their existence necessarily involved in that of man? What necessity is that which holds good in Britain, but not in Ireland; in Australia, but not in New Zealand?

It seems to us that the views which the author puts forward throw a novel light on the commonly-received distinction between necessary and contingent truth, exhibiting, indeed, all truth as necessary. They further seem to warrant the conclusion that evil is necessary, and that its avoidance or prevention do not lie within the scope of the wisdom and power of God. If the existence of man involves the necessity of poisonous serpents, may it not be contended with equal force that the existence of virtue involves the necessity of vice and crime? These questions, however, are beyond the scope of the naturalist.

The question of a fundamental principle or law of organic existence, however, is one which it is impossible to set aside. We see much to which, accepting the doctrine of Evolution in its entirety, we find no clue. We have very grave doubts whether natural selection, or sexual selection, or the conflict of parts within the organism, or the influence of environment can satisfactorily explain the one great fact that no vertebrate animal has more than two pair of limbs. Other such questions will suggest themselves to the thoughtful naturalist. Hence the search after some law which has not yet come in sight is far from vain or needless.

The third essay in this volume, "God and Nature," has been to some extent already noticed in the "Journal of Science" (1880, p. 559). We must reiterate what was then said, that the author's remarks on the alleged atheistic tendencies of Science are exceedingly happy. We quote the passage: "If I might coin a word, I should say that Science was *atheous*, and therefore could not be *atheistic;* that is to say, its investigations and reasonings are by agreement conversant simply with observed facts and conclusions drawn from them, and in this sense it is *atheous*, or without recognition of God. And because it is so, it does not in any way trench upon *theism* or *theology*, and cannot be *atheistic*, or in the condition of denying the being of a God."

This, to be sure, is a distinction which has long been floating in the minds of men of Science, but nowhere have we yet seen it put so tersely, clearly, and forcibly. That the author, as a Prelate of our National Church, should have thus put it, surely entitles him to our grateful appreciation. The same essay enlarges on the importance of a strict boundary-line between the study of God and the study of Nature,—in other words, between Theology and Science. Could this be carried out, the fruitless and unedifying disputes between priest and *savant* would come to an end. But the difficulty is, where and how to draw the line, and this difficulty becomes strikingly evident in the very essay before us. The Bishop criticises, in the first place, certain extracts from the writings of Ernst Haeckel. He quotes the passage, "Everyone who makes a really close study of the organisation and mode of life of the various animals and plants . . . . must necessarily come to the conclusion that this 'purposiveness' no more exists than the much-talked-of 'beneficence' of the Creator." Upon this passage the author makes the following comment:—"We have a denial *ex cathedra* of the existence of such a such a thing as a moral order, or of such a person as a beneficent Creator. This is not merely *atheous*, it is *atheistic*. An investigator of nature has a right to say that the question of the existence of a beneficent Creator, or the non-existence of such a Being, does not affect his investigations; but he has no right, upon the strength of investigations purely physical, to deny the existence of beneficence as an attribute of the Creator, if a Creator there be." We perfectly agree with the Bishop that Professor Haeckel has here gone beyond his rights. Had he, more modestly, declared that the researches of the naturalist throw no definite light upon the moral attributes of God, he would have been distinctly within his rights, and would have taken merely a view which, not long ago, we had the pleasure of hearing most ably enforced by the Rev. Professor Dallinger, F.R.S.

Many readers will find with surprise that the Bishop, in his turn, draws the "frontier line" in a manner which few men of Science will be able to accept, and which we at any rate must utterly repudiate. He writes:—"When *anthropology* is classed amongst the physical sciences, it is necessary to confine the investigations comprehended under the title to the consideration of man as a creature having certain material attributes, and leaving certain material marks of his existence in past ages." And again, "To say that physical science does not include the study of man is perhaps nearly the same thing as saying that man is not a part of nature. . . . Putting aside all question of immortality, it is not difficult to conclude that mankind possess attributes which do not belong to other creatures, and which make it necessary, in examining the world, to put man in a class by himself."

Here, then, we have a re-appearance of the cardinal fault of the Old Natural History,—the consecration of human egoism and arrogance. That this delusion can still haunt such minds as that of the author is a painful instance of the vitality of error. The Bishop's reasons for placing man in a class by himself have already been weighed in the balance and found wanting. Will, purpose, and thought have all been demonstrated in the lower animals. Indeed, to reject this notion of the qualitative distinctness of man, it is not necessary that the student should believe in the "Origin of Man" as sketched out by Darwin and his followers, or should even accept the doctrine of Evolution at all. Let him suppose,—as he has the right to do if he recognises satisfactory evidence—that every animal species has been independently created. Still, if he observes carefully, patiently, and without prepossessions, he will come to the conclusion that man does not and cannot form a class by himself, and cannot be thus regarded without a vitiation of our thoughts, which is by no means confined to zoological science.

We regret that we must here for the present bring our examination of this able and thoughtful work to a close, hoping to resume the task at some future opportunity.

The Science of Man; a Manual of Anthropology, based on Modern Research. By CHARLES BRAY. London: Longmans, Green, and Co.

In this work we find utterances on subjects so many and so varied that were we to examine them all our critique would be bulkier than the volume upon which it is founded.

The author is evidently a man of very wide reading, and what is not by any means a necessary concomitant, of no small originality of thought. That this should be fully acknowledged is all the more fitting, since his love for quotations may make him seem, on a hasty glance, as a mere compiler of the thoughts of others.

Another characteristic of the work is discursiveness. Even in the preface it would be far from difficult to select a number of passages having very scant connection with anthropology. The main feature of the book is, according to Mr. Bray's own statement, "the application of the Conservation, Transmutation, and Dissipation of Energy to Mind, Morals, and Religion"—a task sufficiently difficult. That he is a believer in philosophical necessity rather than in free will—at least in the ordinary acceptation of the term—may be inferred from the very attempt. On the question of the immortality of the soul, "the retention of our identity and personality in another world, of whether the soul be the result of organisation and dependent for its duration on the duration of conditions, or whether it be in itself capable of self-existence," he leaves every man to his own opinion. Yet his own view is evidently against our continuance after death. He considers that "modern research settles the point," and quotes from Professor Owen the dictum that "philosophy does not recognise an immortal entity, mental principle, or soul." Amongst his arguments against the existence of a soul in man there is one, singularly feeble. He quotes from Darwin's "Descent of Man" the passage:—"In a series of forms graduating insensibly from some ape-like creature to man as he now exists, it would be impossible to fix on any definite point when the term 'man' ought to be used;" and he adds, "until that is settled I presume we cannot fix on any definite point when man gets his soul." But this argument implies that the lower animals have no souls—an assumption which has no better basis than the "*sic volo, sic jubeo*" of Mrs. Grundy. We hold that the very same evidence which is urged in behalf of the existence of a soul in man, and of his continuance hereafter applies to the lower animals also, and that the difficulties encountered in either case are precisely similar.

It may seem strange that Mr. Bray, holding the opinions concerning the soul which he evidently does, should tell us that, "mind is not a mode of action or motion, it is an entity itself; it is indestructible." Again, "I know that it is the orthodox opinion among men of science that thought cannot exist without brain, but thought is not a motion of the brain or a mere mode of action at all, and it must exist as force after the movement of the brain ceases, and if so the question is, what becomes of it?"

Concerning spiritual manifestations the author declares that he has "seen more than Science at present credits." Still he pronounces "Spiritualism a nervous epidemic, based on powers of the mind at present unknown."

He is a zealous phrenologist, and to us at least he seems to attach a much greater importance to the now obsolescent doctrines of Gall and his followers than they would merit even if demonstrably true. To do him justice, however, Mr. Bray withdraws one of the assertions of the generality of phrenologists which has proved a fatal objection to their system. They speak in their classifications of certain faculties or sentiments, such as veneration, benevolence, &c., peculiar to man. The observant naturalist clearly traces the workings of these faculties in the ape, the dog, the elephant, &c., and he therefore justly rejects a system so glaringly at issue with facts. But our author concedes the existence of these faculties in the lower animals. He writes:—"It is impossible to affirm that brutes have no conscience or sense of right and wrong; or that they have no veneration, that is respect or reverence, or no benevolence; or that they do not reason." Here there is between him and ourselves the most complete agreement. There is obviously no scope here for a re-discussion of the evidences of phrenology, and we, therefore, pass on to some remarks upon instinct to which we must give a hearty assent. Mr. Bray writes :—"His (man's) pride disclaims any relationship to his fellow creatures lower in the scale of being, so he makes a difference in kind instead of in degree between himself and them, and where he recognises mental superiority, or indeed any kind of intelligence he does not understand, he calls it instinct, which is a mere name to cover his ignorance, and to support a foregone conclusion about some kind of soul which the brutes are supposed not to possess." Again, "We do not understand the language of the creatures below us, the study of which would be much more profitable and very much more interesting than Greek and Latin ; for we should then learn how Nature in its infinite experience has found out how best to do most of the things we wish to accomplish, has stereotyped the knowledge and handed it down to us in what we call instincts."

Mr. Bray is an Evolutionist of the Darwinian School, and believes in the beneficence, or rather the necessity, of natural selection. He considers pain essential. He holds with Herbert Spencer that "pressure of population has been the proximate cause of progress," and he quotes with approbation the proverb, "necessity is the mother of invention," taking the word necessity in its ordinary sense. Here we can agree with him, but to a very limited extent. Inventions are seed of very slow growth, and are about the unlikeliest expedient that a man suffering from necessity, *i.e.* want, can embrace. They generally require much time, considerable outlay in experiments, an undisturbed mind, all of them conditions incompatible with necessity. As for discoveries, as distinct for inventions, they, as a rule, bring no pecuniary reward to their originators. What did Darwin profit, in the commercial sense of the word, by his researches ? If not in independent circumstances he could never have undertaken them. It is this principle which makes us dread the increasing competition of the present day, which by compelling men to spend an ever increasing portion of their time in business, leaves them less and less scope for improvement. Nay, why need we argue further ? Mr. Bray himself writes (p. 289). "Our race is over weighted and appears likely to be drudged into degeneracy by demands that exceed its powers. Men are over-worked and require an artificial stimulant before the jaded nervous system is capable of enjoyment." It may be granted that if competion were absolutely removed, the bulk of the race might fall into a state of listlessness not favourable to improvement. But like heat, food and rest—all of them prime necessaries of life—it is fatal, individually and racially, if in excess. And that excess, or in other words intemperance, is well-nigh forced upon the bulk of mankind in civilized communities.

That the author is not an admirer of the morbid, one-sided commercialism of the present day may be learnt from this passage, which we cordially endorse :—

"Our economical system aims more at the creation of wealth than the making of men. No doubt we might lose much in productive power by a general liability to military service, as is customary in Germany, but what we lost in wealth we might gain in health and happiness. We turn our men into tailors and men-milliners, and keep them to occupations behind the counter fit only for women, but it would tend greatly to the development of both their physical and mental powers if they were trained to handle the sword and rifle.

"The attention given in this country is too exclusive, and a term of military service might well supplement the ordinary education, and give to Anglo-Saxon liberty what it most wants —a power of obedience, order, and organisation. . . . All moral advance must be based upon impoved physical conditions." In this connection we may refer to the "Man of the Future," described in a contemporary by Mr. E. Kay Robinson as "a toothless, hairless, slow-limbed animal, incapable of extended locomotion and a lover of peace at any price." Unless all nations were to move in this direction at an equal speed the more "advanced" will infallibly be extirpated.

Mr. Bray raises a question as to the cessation of progress in the civilization of the Far East. We think the answer may be found in the character of Chinese education, which for many centuries has been exclusively literary and examinational. For centuries minds have been gauged not by their power of origination, of adding to human knowledge, or of applying such knowledge in possible emergencies, but by their receptivity, their power of appropriating, retaining, and answering questions in the thoughts and sayings of others. When our Civil Service Commissioners, our Department of Science and Art, and our examining Universities have been at work for a sufficient time, we, too, as a nation shall have become stereotyped.

There are some five-and-twenty more passages which we should have been happy to examine in detail did space allow, including such subjects as missing links, hard water, euthanasia, vegetarianism, woman's rights, soul-emanations, protoplasm, the "Caucasian" race, the smell of the insane, and the subjectivity of matter. That there are in the book certain statements not in harmony with the latest results of scientific investigation must be admitted. But the omission or the correction of these errors would not essentially modify the character of the book.

The author's attempt to apply the principle of the Conservation of Energy to so-called moral questions has not, in his hands, led as yet to any fruitful results, yet his attempt is worthy of careful re-consideration. In such an undertaking, success like the olive tree, typical plant of Pallas, will not reach maturity quickly. Few, if any, will be disposed to accept all the opinions contained in this book, but few if any thoughtful men can read it without advantage.

Elementary Treatise on Physics, Experimental and Applied, for the use of Colleges and Schools. Translated and Edited from "Ganot's Elements de Physique." By E. Atkinson, Ph.D., F.C.S. Professor of Experimental Science, Staff College, Sandhurst. Eleventh Edition, revised and enlarged. London: Longmans, Green, and Co.

When the translator and editor of this book speaks of the "continued and still increasing favour" with which it has been received as a text-book for colleges and schools, and as a work of reference for the general reader, he does not in the least exaggerate. For a scientific treatise, necessarily somewhat costly, and containing nothing of a sensational character to reach eleven editions in twenty years is not a common occurrence, and proves certainly that the merits of the book must be very widely recognised among professors and teachers of physics.

The present edition has been considerably enlarged, the arrangement of certain portions has been altered for the better, and the results of many investigations completed or extended since the appearance of the tenth edition have been duly inserted.

Thus the chapter on the steam-engine has been re-written, a notice of Twaddell's hydrometer, wanting in the French original has been inserted. The "critical point" met with in the experiments on the liquefaction of gases has been explained more fully, and a good definition of "vapours" in accordance with the present state of Science is supplied. An account of the relation between vapour densities and molecular weights has also been added. As might, perhaps, be expected the most important additions and revisions have been made in the books dealing with electricity. We find here a more complete account of secondary batteries, a notice of Pacinotti's ring, and of the dynamo-electrical machines of Siemens and Brush. Under electro-dynamics we find important paragraphs added on mechanical units, electrical units, electrostatic units, electro-magnetic units, practical units, and on the relation of the electrostatic to the electro-magnetic unit.

A few passages only may seem to require revision. Thus on p. 3 we find a passage which might be construed as implying that hypothesis and theory were simply convertible terms. On p. 111 we read an account of the phenomena occuring when dilute alcohol is kept in a bladder not in harmony with the most recent investigations. Nor can we unreservedly accept the account of anticyclonic systems given on p. 929.

In other respects we have observed nothing to which exception can be fairly taken. Omissions will doubtless be detected by the specialist in the various branches, but to record every phenomenon and every generalization in so wide a subject formed no part of the plan of the work, and would have been indeed in a book of moderate compass simply impracticable. Probably no work in the language is so well adapted to serve at once as a college text-book and as a manual for reference. If we may suggest any improvement it would be the introduction at the end of each section of a condensed bibliography.

Life of Sir William E. Logan, LL.D., F.R.S., &c., First Director of the Geological Survey of Canada. By BERNARD J. HARRINGTON, B.A., Ph.D. London: Sampson Low, Marston, Searle, and Rivington.

IN geology, unlike chemistry and physics, the primary facts from which laws are deduced, and upon which theories may be founded are to be met with, not in the quiet of the laboratory, but in the ravine, the landslip, the mine, and the quarry. Hence the search for such facts, more especially in "new" countries, involves travel, hardship, and adventure, as well as an almost unlimited expenditure of time. Among those who have devoted the better portion of their lives to this kind of active exploration, a high and honourable place rightly belongs to the subject of this memoir,—the founder of the Geological Survey of Canada. Sir William Logan, though of unmixed Scottish parentage, was born at Montreal, but was sent in his sixteenth year to be educated at the High School of Edinburgh. His training was exclusively classical,—in other words, verbal. But he must have had sterling metal in his composition, since his school career did not, as has been the case with so many, render him unobservant, and incapable of attending to and learning from things. There can, however, he little doubt that a more rational education would have enabled him to take a higher rank as a man of Science in after life. In 1816, he entered the University of Edinburgh classes in mathematics, logic, and chemistry. Concerning the latter subject, he writes, "as to the chemistry, at it prizes are never given." Thus it appears that nearly seventy years ago the unhappy system of "prizes" had become one of the characteristics of British education. To geology, his attention does not seem to have been drawn, though John Playfair was at that time one of the Professors. William Logan's college career, however, soon came to an end, for, in 1817, he went to London, and took a position in the mercantile establishment of his uncle, Hart Logan. Here he remained for many years, and would doubtless have been entirely lost to Science but for what is conventionally called an accident. His uncle became connected with some mining and metallurgical speculations in Wales. William Logan accordingly removed to Swansea in 1831, to look after his interests, and it is only then, in his thirty-third year, that his life, from our point of view, may be said to have begun. Here he attended, in the first place, to copper smelting and coal mining. He was led to study the question of the origin of the latter mineral, and the structure of the Glamorganshire coal field. With that unlimited capacity for hard work which was one of the main features of his character, he contrived, in his spare time, to produce a good geological map of the district. This map he handed over to Sir Henry de la Beche, when the Geological Survey of South Wales was begun. It was accepted and officially adopted. In 1837, Logan was elected a Fellow of the Geological Society, and in the same year his map of the South Wales coal region was exhibited at the Liverpool Meeting of the British Association, and was much admired. He was an active worker for the Royal Institution of South Wales, which he served in the capacities of Honorary Secretary and Curator of the Geological Department, and which he enriched with an extensive collection of minerals and metallurgical products, as well as with an assortment of Canadian birds, many of them previously undescribed. These he had both shot and stuffed himself, when on a visit to his native country.

His greatest achievement during his stay in Wales was his establishment of the growth of coal *in situ*. He showed that the so-called "underclay," invariably occurring beneath the coal-seams, always contained the roots of a tree then known as *Stigmaria ficoides*, but now proved to be a *Sigillaria*. These roots were in such positions that they could not have drifted, but must have grown on the spot. These observations, which have been confirmed by investigations made in Germany, Nova Scotia, the United States, and elsewhere, were laid by Logan before the Geological Society in February, 1840. In the same year he left England for Canada, with the intention of there continuing his geological researches.

Here he drew up, and communicated to the Geological Society, a paper on the packing of ice in the St. Lawrence and its geological action. He visited the coal fields of Pennsylvania, and was gratified to find beneath every seam the underclay, and the *Stigmariæ*, just as in South Wales. During this journey he met with Lyell, at New York.

The question of a geological survey of Canada had from time to time been mooted since 1832, but it was not untill 1842 that a beginning was made in earnest. De la Beche, Murchison, Sedgwick, and Buckland strongly recommended Logan for the office of Colonial Geologist. In August, 1842, he received his formal appointment, and speedily entered upon what Sedgwick called his "Herculean task." His operations, when detaching fossils from the rocks, excited sometimes a troublesome degree of curiosity, passers-by often supposing that he was seeking for buried treasures.

To give a sketch, even in the most summary fashion, of his explorations is obviously impossible within the space at our disposal. But we must coincide with the general opinion that, considering how late in life his geological career began, and under what unfavourable circumstances he worked, his results are truly marvellous, both in their extent and their value. What might he not have accomplished had he not wasted some fourteen of the best years of his life in his uncle's counting-house!

His labours in exploration were twice interrupted by exhibitions. For the London Exhibition of 1851 he had prepared a very important collection of the economic minerals of Canada, and he was appointed a juror in the Mineralogical and Metallurgical department. On this occasion he was elected a Fellow of the Royal Society. Dr. Harrington somewhat drily remarks that leave of absence had been, indeed, given to Logan that he might attend the Exhibition, but that "he was allowed the privilege of paying all his own expenses."

In 1855, he had again to prepare for the Paris Exhibition, which he attended as "Special Commissioner." He received a Grand Gold Medal of Honour for his maps and minerals, and was made a Chevalier of the Legion of Honour. In addition, Dr. Barrington informs us that a "greater distinction awaited him at the hands of his own Sovereign." This was simply the rank of knighthood, which, considering the class of men upon whom it is often conferred, is no very dazzling honour. The Geological Society awarded him about the same time the Wollaston Medal. One of the Royal Gold Medals was subsequently conferred upon him by the Council of the Royal Society, and in 1867, the Emperor of the French raised him to the rank of Officer of the Legion of Honour. In 1869, though he had hoped for the time when his explorations should extend from the Atlantic to the Pacific, advancing age compelled him to tender his resignation. In 1874, he crossed the Atlantic for the last time, and on June 22, 1875, he died at Castle Llechryd, in Wales.

Of chemistry, mineralogy, and palæontology Logan had but a limited knowledge. His strength was in stratigraphy. But he was always ready to avail himself of the services of others in those departments where he was deficient, and to give them due credit. Dr. T. S. Hunt, who has since earned so high a reputation, became chemist and mineralogist to the Survey in 1846. As a theorist, Logan never attempted to distinguish himself. It was his task to search out facts, and leave their coordination to others.

Dr. Barrington has fulfilled his task ably and conscientiously, and has produced a book which deserves a favourable reception not alone within scientific circles.

Proceedings of the Bristol Naturalists' Society. New Series, Vol. IV., Part I. (1882-3).

THE first paper in this number treats on the "Iron Turnings Galvanic Cell and the supposed Influence of Points in the Liberation of Bubbles." The author, Mr. A. M. Worthington, shows that the common notion that points and edges determine the formation of bubbles in boiling liquids, &c., is a mistake, and that the phenomenon observed is due to the appearance of bubbles near points and edges, which, from their very nature, indicate a rough and cavernous region of the surface.

Mr. James A. White contributes a note on a colony of alien plants found on the slope of a hill at Kingswood. Within the compass of about 50 yards by 25 the author found twenty species alien to Britain, and seventeen others which—though met with in other parts of the country—were alien to the Bristol coal-fields.

Mr. Worthington exhibited to the Society, and described, an apparatus for observing splashes.

Mr. E. Wethered, F.G.S., F.C.S., read a paper on the porosity and density of rocks with reference to water-supply. The author points out a consideration not to be overlooked by the advocates of deep-well water for "potable purposes." * That is, in certain rocks the water may pass through joints and fissures, undergoing little filtration, so that its freedom from organic impurities is not a matter of course.

Two papers, "Rainfall at Clifton in 1882" and "Thirty Years' Rainfall at Clifton," both by Dr. G. F. Burder, F.M.S., are of general interest. A graphic representation of the rainfall between the years 1853 and 1882 inclusive, shows apparently a progressive increase of this great enemy to British agriculture. From 1853 to 1859 the average downfall was 29·317 inches; from 1860 to 1869, 34·084 inches; from 1870 to 1879, 36·524 inches; and for the three years 1880 to 1882, 39·919 inches! For excess of rain the author considers that the ten years just past are without a parallel. Of course the figures given admit of two interpretations. They may indicate an increase in the rainfall which will not merely continue, but be still further augmented in the futnre; or they may be merely a fluctuation to be compensated sooner or later by a series of dry years. But the only way to solve this vital question is continued observation. If the former interpretation is correct Britain must cease to be habitable, and the idea of a "national exodus" must be seriously entertained.

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* In justice to the author we must add that this strange expression occurs in a quotation from a Report of the late "Royal Rivers Pollution Commission."

Professor Silvanus P. Thompson gives an account of the first telephone, as invented and exhibited by Philipp Reis in 1861.

Mr. H. J. Charbonnier communicated some notes on Ridgway's "Catalogue of North American Birds" (1881). The author recommends the adoption of a ternary nomenclature in place of the present binary system. The reason, or rather the need, for such a change lies in the number of local forms or sub-species, which by naturalists of "splitting" propensities are being made to take the rank of species. As an example of the working of the new system he takes the two woodpeckers described by Swainson,—*Colaptes auratus* of Eastern North America, and *C. Mexicanus* of the Pacific coasts. Since then an intermediate form has been discovered, and has been ranked by Baird as *C. hybridus*. Ridgway's Catalogue, however, deals with these three forms as follows:—

"378. *Colaptes auratus*. (The commonest and best-known form.)
"378 *a*. *Colaptes auratus Mexicanus*. (The western form.)
"378 *b*. *Colaptes auratus hybridus*. (This form is a true hybrid, produced from the other two, and occurs on the Upper Missouri.)"

Mr. Charbonnier very justly remarks:—"Our knowledge of species would greatly gain by a more accurate and scientific method being adopted by collectors. There is an infatuation amongst them for collecting only "British birds," whatever they may understand by that vague expression; or, worse again, "British birds' eggs," the actual *specimens* of eggs so designated being in the majority of cases obtained on the Continent or elsewhere, and very often are laid by birds sub-specifically different from those whose name they bear."

We fully admit that a thorough knowledge of the organic life of Britain is desirable, though it is but an impoverished outlying portion of the Palæarctic region. But we never can attain this knowledge if we refuse to study British animals and plants in connection with their Continental representatives.

Mr. Cedric Bucknall continues his elaborate monograph of the "Fungi of the Bristol District."

A paper by Mr. J. G. Grenfell, on "Evolution in the Protozoa," is briefly abstracted in the "Report of Meetings," but is unfortunately not printed in full. The Botanical and Entomological Sections, we are sorry to find, have not been very active.

The volume closes with a continuation of the "Flora of the Bristol Coal Field," edited by Mr. James Walter White.

Appendix to Contributions to Natural History, and Papers on other Subjects. By JAMES SIMSON. New York: James Miller.

To us, as a naturalist, this little work is disappointing. The "Contributions" themselves contain only 49 pages of matter dealing with Natural History, whilst 122 pages—or nearly three-fourths of the whole—are devoted to Romanism, John Stuart Mill, the social emancipation of the Gipsies, the question "Was John Bunyan a Gipsy?" and the Duke of Argyll on the preservation of the Jews.

The Appendix now before us consists of four essays:—

I. John Bunyan and the Gipsies.
II. Frank Buckland and White of Selborne.
III. Frank Buckland on the Viper. And—
IV. On the Endowment of Research.

The first of these papers lies distinctly outside of our jurisdiction. Had John Bunyan been a man of Science, or an opponent and enemy of Science, his nationality might have been legitimately here discussed. As he did not come in contact with Science at all, we must simply leave the question to be dealt with by the literary organs.

The second essay is much more to the purpose. Like Prof. Browne, Goode, and Miss Hopley, Mr. Simson maintains, inopposition to the late Frank Buckland and others, that young vipers and possibly other serpents, when in danger, take refuge down the throat of their mother. Though we have devoted much time to the observation of vipers, both in their native haunts and in captivity, we had never the good fortune to witness this swallowing process. Still, from the evidence which has been brought forward, we consider it must be received as an established fact.

Mr. Simson passes on to notice Buckland's edition of White's "Selborne," a performance which, the "Examiner" remarks, "has already succumbed under its own presumptuous inefficiency." Mr. Simson shows that Buckland took most unpardonable liberties with the author's text. Of White's notes twenty-four are suppressed, twenty-four more used as notes but with nothing to distinguish them from Buckland's own, and thirteen are incorporated with the text.

In the third essay we have the same subjects again brought forward.

The last memoir, "On the Endowment of Research," may perhaps be styled discursive. There is little, very little, concerning the ostensible subject. But by way of compensation we find the Duke of Argyll's opinions on the preservation of the Jews, Mr. Borrow's writings on the Gipsies, the irrepressible John Bunyan, Buckland and English snakes, the "Scotsman," John Stuart Mill and his father James, in addition to "Blackwood's Magazine" and Charles Waterton. We note the following passage:—"Indeed George Borrow, Frank Buckland, and Charles Waterton may be described, without offence, as three impulsive, headstrong, *ex cathedrâ*-talking dogmatists, incapable, when left to themselves, of constructing an argument of a complex nature, or of giving a satisfactory exposition of an intricate subject that could stand scrutiny. To train a 13-inch bomb on them in that respect would be superfluous, for a thimblefull of sparrow-hail would suffice." Now of George Borrow we know practically nothing. Frank Buckland we certainly consider to have been over-estimated, and in a notice of his posthumous work on the "Natural History of British Fishes" ("Journal of Science," 1881, p. 292) we referred to some of his shortcomings. We are also not blind to the defects of Waterton as a naturalist (*see* "Journal of Science," 1880, p. 638). But Mr, Simson's style of discussion seems to us needlessly personal, and not well adapted to promote the cause of scientific truth.

NOTICES.

Several important works sent to us for review still stand over from want of space.

In connection with the notice of Mr. Gerald Massey's "Natural Genesis," in our last number, we must add that the copy we received consisted merely of the advanced sheets of the first volume. The work is published by Messrs. Williams and Norgate, London.

ERRATUM

Page 319, line 9 from top, *for* "should be used" *read* "should not be used."

CORRESPONDENCE.

⁎ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

ATLANTIS.

To the Editor of the Journal of Science.

Sir,—After all that has been said about this lost country during the last three thousand years,—or perhaps I should say after all that has come to light concerning that which has been said of it,—thoughtful people ought to admit that it is more likely such a country existed than that it did not, and careful search should be made for more evidence than has as yet been produced of its existence. There is the tradition handed down from the Egyptian priests, and other traditions independent perhaps of that particular one. Is it not possible that the Egyptians themselves were colonists from Atlantis, seeing that their remains are so similar to those of the old Americans, themselves perhaps colonists from the same country? And there is the Sargoza Sea, through which indeed I have sailed, and cannot wonder that it may have been formerly—and in parts really now—so dense as to prevent the passage of ships, so that those in them may have perished miserably.

During the great number of years that I have been in Borneo and the neighbouring islands, it may be supposed that I have not had many opportunities of reading; therefore I may perhaps be pardoned for saying that I do not remember that much is known, or at least related, concerning the people who inhabited the northern coasts of Africa during the time of the early Egyptian kings, nor of the western coast, nor of that of Portugal, the inhabitants of which countries must have been in constant intercourse with those of Atlantis. Have the round towers on the coast of Portugal been as yet accounted for? And have the libraries of Lisbon, and especially Mafra, been yet examined? Have any steps been taken on the west coast of Africa to obtain evidence, or relics? I think not; except that some one made verbal enquiries once at the Cape de Verde Islands. In fact I may say, in conclusion, that no special enquiry has yet been set on foot concerning Atlantis, and it appears to me that one of the most interesting questions of the day should be allotted its share of investigation.—I am, &c.,

Cl. de Crespigny.

[This communication is the more interesting because the writer does not appear to be acquainted with certain recent speculations in this direction, and in particular with the work of Mr. Donnelly reviewed in our June number.—Ed. J. S.]

NATURAL IMITATION.

To the Editor of the Journal of Science.

Sir,—The following remarks of Gordon Cumming ("Two Years' Adventures in the Interior of South Africa") appear to me worthy of being separated from the text of what is generally conceived to be merely an amusing hunting work. The remarks are profound and most interesting to naturalists, and when its date is considered (October, 1843) places its author high in the lists of natural observers, preceding as it does the observations of both Bates ("The Naturalist on the Amazons") and Wallace ("The Malay Archipelago"). The remarks are the more interesting as they are detached from all technical ideas, and were not written to support any particular theory. In the many works I have read on this interesting subject I nowhere find the original observance of this peculiar natural phenomenon is given to Gordon Cumming.

"There can be no doubt that every animal is seen to its greatest advantage in the haunts which Nature destined them to adorn" (witness Waterton's observations on the Sloth), "and amongst the various living creatures which beautify this fair creation I have often traced a remarkable harmony between the form of the animal and the general appearance of the locality in which it is found: this I first remarked at an early period of my life, when Entomology occupied a part of my attention. No person following this interesting pursuit can fail to observe the extraordinary likeness which insects bear to the various abodes in which they are met with: thus among the long grass we find a variety of long green insects whose legs and antennæ resemble the shoots emanating from the stalks of the grass, that it requires a practical eye to distinguish them. In sandy districts varieties are met with of a colour similar to the sand which they inhabit. Among the green leaves of the various trees of the forest innumerable leaf-coloured insects are to be found; whilst closely adhering to the rough grey bark of the same trees, we observe beautifully coloured grey-looking moths of various patterns, yet altogether so resembling the bark as to be invisible to the passing observer. In like manner among quadrupeds I have traced a corresponding analogy, for even in the case of the stupendous elephant the ashy colour of his hide so corresponds with the general appearance of the grey thorny jungles which he frequents throughout the day that a person unaccustomed to hunt these animals, standing on a commanding situation, might look down upon a herd and fail to detect their presence; and further, in the case of the giraffe, which is invariably met with among venerable forests, where numerous blasted and weather-beaten trunks and stems occur, I have repeatedly been in doubt as to the presence of a troop until I had recourse to my telescope; and on referring to my savage attendants, I have known even their practical eyes deceived, at one time mistaking these dilapidated trunks for camelopards, and again confounding real camelopards with those aged veterans of the forest."—(Edition, 1856.)—I am, &c.,

S. Billing.

THE NICETY OF BIRDS.

To the Editor of the Journal of Science.

Sir,—Permit me to make an addition to the facts given under this title by H. M., in your February issue. A pair of love-birds in my possession always bury any object which they dislike under the husks of the millet which forms their food. A strawberry was once given them, in the supposition that, like most of the Psittacidæ, they would relish fruit. It disappeared, and I thought it had been eaten, but the next day, on cleaning out the cage, the missing strawberry was found carefully buried in a heap of sand and millet-shells.—I am, &c.,

E. A. S.

AN EGG WITHIN AN EGG.

To the Editor of the Journal of Science.

SIR,—In "Gardening Illustrated") June 23, 1883) Mr. H. E. Sprengle, of Grimsby, states as follows :—" On June 1st one of my Brahma hens laid an egg which on account of its large size I determined to blow out and preserve. During the process I found, to my astonishment, that the egg contained another egg within. There was the white and yolk to each, and the shell of the inner egg was as hard as that of the outer one, I succeeded in blowing them both without accident. The egg measured in circumference 9 inches by 6¾ inches, but the inner one was barely half that size."

This appears to be a fact worth preserving; therefore I send to your Journal the cutting.

Some years ago I found a tolerably large cinder in an egg, which has been a continual wonder to me; but an egg within an egg transcends my wonder, and points to the mode how the cinder got into the egg.—I am, &c.,

S. BILLING.

NOTES.

In visiting the Engineering Exhibition at the Islington Agricultural Hall, Islington, we were particularly struck with the aluminium alloys exhibited by the Aluminium Crown Metal Company working under Webster's Patent. It seems to us that, for the manufacture of scientific apparatus, the days of brass are ended. The superior hardness and strength of the new metal, its lightness, and immunity from the oxidising and sulphurising action of the air are most signal advantages, which must more than compensate for its higher price.

The "Textile World" remarks:—"The bane of the administration of the South Kensington Museum is that its contents are being perpetually shuffled about, as if it were meant merely to amuse the public with a sort of colonial kaleidoscope. Will it be believed that instead of showing the portion of Mr. Clarke's textile fabrics which are exhibited in the India Museum in combination with the old historical collections of these manufactures, the latter have all been removed out of sight to make more room—and far more than was necessary—for the former, thus throwing away all the advantages manufacturers and other experts would have derived from a close comparison of the two collections? Moreover, the new chintzes and carpets are without labels, even general ones, and are so inartistically hung that they produce a most slovenly effect. The lower gallery in which they are shown being also very closely packed with the miscellaneous collections of the Prince of Wales's Indian presents, and the miscellaneous loans of the Royal Asiatic Society, the whole place has the appearance rather of a cosmopolitan mercantile store than of a scientifically arranged art museum." How is it that nothing more is heard of the promised India and Colonial Museum which was to have been erected in a central and accessible place, the Thames Embankment?

According to Drs. Weir, Mitchell, and Reichert ("Medical Press") snake-venoms have always an acid reaction, re-dissolve in water after drying, and contain no alkaloid. They consist of three distinct proteids. The first of these is a peptone, less active than the combined poison, but inducing œdema and putrefaction; the second (the "cobric acid" of Dr. Winter Blyth?) is the most virulent, and in a few minutes after injection produces infiltration of blood into the neighbouring tissues; the action of the third is doubtful.

M. Venukoff ("Comptes Rendus") gives a summary of the scientific results obtained by Col. Prejevalsky in his last Expedition in Central Asia. He has established the former existence of glaciation on a vast scale in the north of Thibet. He notices strong westerly tempests, unaccompanied by lightning, which occur almost daily in the deserts of Dzoungaria and on the tablelands of Thibet. His collections include 90 species of mammals, 400 of birds, 50 of reptiles, 53 of fishes, an unknown number of insects, 1500 plants. He has discovered the horse and the camel in their wild state, and the mountain goose. The animals were so accustomed to man that they showed no alarm even after some of their number had been shot. He clearly traces the origin of the loess, so vastly developed in Eastern Asia, to the action not of water, but of wind. This amount of work is all the more wonderful if we consider that scientific research is, after all, not the esoteric motive of the Expeditions of Col. Prejevalsky.

Prince Roland Bonaparte is about to publish a series of essays on anthropology,

Prof. Huxley, in the recent Rede Lecture at Cambridge, surprised his hearers by producing an extremely Evolutionist passage to be found in the "Natural Theology" of Archdeacon Paley!

The Albert Medal of the Society of Arts has this year been awarded to Sir Joseph D. Hooker.

A strange incident happened at one of M. Brown-Séquard's Lectures on Experimental Physiology, at the College de France. As he was about to begin his operation a female Bestiarian dashed the scalpel out of his hand with her umbrella. She was removed by a policeman, protesting volubly all the way.

Miss S. L. Andrew ("Popular Science Monthly") gives interesting particulars fully proving that the common garden petunia (*P. grandiflora*) is an insectivorous plant. (Everyone must have noticed that its odour is very attractive to insects, especially at nightfall, but the purpose of the attraction was hitherto unsuspected.)

M. Daubrée ("Comptes Rendus") gives an account of a meteorite which fell between Nogoga and Concepcion, in the province of Entre-Rios, La Plata. It belongs to the rare class containing carbon in a state of organic combination.

According to the "Spiritual Record," "Stuart Cumberland" is now practising vigorously in America.

The Rolleston Memorial Fund reaches £1200, and has been delivered over to the University of Oxford to found a prize for original research in animal and vegetable morphology and physiology, which will be awarded every two years.

The facts collected by Miss Ormerod prove the alarming extent of the injury occasioned by insects even in this country. The loss last year, due to Aphides, comes close upon two millions sterling; whilst the damage wrought by wireworm, weevil, &c., to wheat, barley, peas, beans, and tares seems to range from £2 to £3 per acre.

We learn that the introduction of "many English birds" into Tasmania is projected. We should advise here great caution. The English native fauna and flora number very few species worth introducing.

Prof. Simon Newcomb ("Monthly Notices Roy. Astr. Soc.") refutes the charges of falsification which have been brought against Hell as regards his observations of the transit of Venus in 1769.

The "St. Petersburg Med. Wochenschrift" reopens the question of the sanity and legal responsibility of Guiteau. It holds that the assassin, though not formally insane, was all his life on the margin of insanity, and advocates the doctrine of a graduated responsibility.

It is asserted in some quarters that the discovery of electromagnetism is due not to Oerstedt, but to Giovanni Romagnosi, an Italian.

Prof. Owen ("Geolog. Mag.") having received the outline of an entire skull of *Thylacoleo* points out the expansion of the temporal fossæ as being additional evidence for the carnivorous character of this extinct species.

Mr. Searles V. Wood ("Geolog. Mag.") argues that the cause of the glacial period was a diminution in the heat-emitting power of the sun. He shows, in opposition to Dr. Tyndall, that decreased evaporation does not imply a diminished snowfall. This view is necessarily at issue with the dynamical theory of the sun's heat, a doctrine which harmonises badly with the teachings of geology and biology.

It is insinuated that eminent men of Science who ten years ago leaned to the materialistic interpretation of the universe are now "hedging" very judiciously.

The Concord Summer School of Philosophy is at work, and will doubtless prove fruitful in remarkable sayings.

Herr Munk ("Verhand. Physiol. Gesell. Berlin") proves experimentally that neutral fats can be formed synthetically in the animal system from free fatty acids.

At the July meeting of the Entomological Society a paper, by Mr. Lewis, on the Lucanidæ of Japan was read. The author contends that here, as well as among the Longicornes, Buprestidæ, &c., the larger species show great individual variation in size according to the supply of food. In smaller species, and in groups where the larva can seek its own food, the size is approximately constant.

Mr. A. R. Wallace has been elected a foreign member of the Dutch Society of Sciences, at Haarlem.

Dr. Sluiter is endeavouring to establish a zoological station in Java,—a locality which will afford ample scope for interesting research.

Drs. Mitchell and Reichert ("American Naturalist") have proved that the bite of *Holoderma suspiciosum* may be fatal. The venom, unlike that of serpents, is alkaline.

According to J. C. Hughes ("Forest and Stream") pigs in British Columbia have learnt to dive for salmon in the clear rivers.

As far as scientific eminence and merit are concerned, the suitability of Prof. Huxley for the Presidency of the Royal Society is universally admitted.

MM. Carl Vogt and Emile Yung, in their "Traité d'Anatomie comparée," insist that distinct animal sources may give rise to series of beings, some of which may mutually approximate and tend to be confounded together. "Thus we may place in the same class, the same order, and even in the same genus, species whose ancestors were originally perfectly distinct."

M. H. de Varigny ("Comptes Rendus") has examined the influence of the various salts present in sea-water upon freshwater animals. He finds that calcium sulphate and carbonate have no influence; magnesium sulphate and chloride and potassium chloride (in the proportions present in the sea) very little; the injurious action being due to the common salt.

M. K. Müllenhoff ("Naturforscher") has at last solved the question of the cells of bees. He proves that their peculiarities are due neither to high intelligence nor to a miraculous "instinct," but simply to certain physical conditions, which we shall explain in full.

Dr. Burmeister has discovered, in La Plata, a fossil sloth, twice the size of any now living, but apparently of arboreal habits.

Dr. C. C. Abbott ("Science") records the fact of crows capturing mussels at low tide, carrying them inland in the beak (not the feet), and letting them fall to break the shell; then returning for fresh booty to the shore, until the rise of the tide put an end to their fishing. Then, and not till then, they hastened to feed upon their prey, evidently understanding the nature of the tides, and knowing that the time for such sport was short.

The "Medical Press and Circular," quoting an address delivered by Dr. Balthazar Foster, makes some apt comments on the "Political Powerlessness of the Medical Profession." Were this otherwise the Bestiarian hubbub would have been less formidable.

An American naturalist proposes the generalisation that every particoloured cat has the tip of its tail black, and every particoloured dog the tip of its tail white. This is not strictly correct, since there are buff and white cats without any black spot, and black and tan dogs without a trace of white.

Dr. A Rizat speaks of the Græco-Latin terms used in Science as being sometimes misunderstood, even by their inventors.

The "Transactions of the New York Academy of Sciences" give an instance of how popular natural history is manufactured. A certain author asserts that "while at Bermuda he had seen an *Octopus* leave the water and climb a cliff 200 feet high, in pursuit of a red crab." The "Transactions" show, in comment, that there is no cliff of any kind in Bermuda 200 feet high; that there is no crab on the Bermudan shores having a red carapace; and that the only species of *Octopus* known there never leaves the water.

Prof. Spring, of Liège, endeavours to show that free carbon is in a dead state, and that previous to entering into organic compounds, and still more into the bodies of living beings, it must undergo two successive depolymerisations, which endow it with new properties. He does not, however, show how the second depolymerisation is to be effected.

A recent writer on medical electricity announces, as a great discovery, that "electricity acting on flesh deprived of blood or fluid is a deadly poison." How he got the flesh of any living animal into such a state, and yet retaining its vitality so as to be capable of being poisoned, is not explained.

Mr. Edison believes that means will ultimately be found to obtain electricity from the earth without the use of any machinery whatever.

According to the "Medium and Daybreak" Swedenborg claimed the invention of the torpedo, the mitrailleuse, the hydraulic lift, and the discovery of the circulation of the blood.

The Public Library of Melbourne, as well as the Art Gallery and Museum, are now open on Sunday afternoons.

On the 16th ult. a most able paper on the "Preservation of Fish Life by excluding the Pollution of Town Sewage" was read at the Fisheries' Exhibition, by the Hon. W. F. B. Massey-Mainwaring. In the discussion which followed all the speakers expressed their preference of the chemical treatment of sewage as against irrigation, pumping into the sea, &c.

According to the "Medical Press" Prof. Schuethauer, of Pesth, in making a post-mortem examination of a woman aged 70, found that the spleen was absent, and had never existed.

The director of an ultramarine works in Germany is reported to have observed that during forty years none of his workmen have been affected with pulmonary consumption. This immunity is ascribed to the sulphur fumes pervading the works. This observation, if correct, tends to support the "germ theory" of the origin of phthisis.

The influx of the rural population into the great cities is in Europe regarded with alarm and regret. We were no little surprised at finding a writer in an American contemporary congratulating his countrymen on the "progressive emancipation of the people from an agricultural life."

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THE

JOURNAL OF SCIENCE.

SEPTEMBER, 1883.

I. THE VELOCITY OF LIGHT.*

By O. Reichenbach.

> "Hence the agreement or disagreement of the values of V and *v* furnishes a test of the electro-magnetic theory of Light."—Clerk Maxwell.

ALL matter† being equally subject to gravity, the variety in its distribution leading to variety of motions can be the only cause of variety of matter.

Laplace's $V=\sqrt{gHK\div D}$ gives for air, at 15·22 C., the mean temperature at the surface of the earth, under 760 m.m. pressure; the velocity of sound 345 metres in a second. The atmosphere, however, contains water-stuff in every form, which wind raising accelerates and retards sound.

The water-stuff always in the air, o. s. p., is 347 centims. over the earth, the 1÷29·78 of the mass of the atmosphere. This water propagating sound with a velocity to that in air as the respective specific heats 4·25 : 1, the mean increase of the velocity of sound through the whole of the atmosphere is 51 metres:—

$$345 \text{ m.} + 51 \text{ m.} = 396 \text{ metres},$$

which is the mean rotary velocity of the surface of the earth, o. s. p.

---

* Referring frequently to "On some Properties of the Earth" (Wertheimer and Lea: London, 1880) I designate it by o. s. p.

† In 1849 I wrote, not unprophetically, "Without matter no sound. Sound deranges the parallelism of the light orbits of atoms. Sound gives an image. Sound displaces light; one might possibly observe oscillations of the dark rays of light by a strong sound; the more elastic the medium through which the light moves, and the denser the medium on which it is received, the better. With patience one might magnetise iron by sound."

This solar aqueous disturbance is regulated in its more and less by the 7·78 times the 347 centimetres are annually renewed; we have—

$$(396 \text{ m.} - 347 \text{ m.}) \div 7{\cdot}78 = 6{\cdot}58 \text{ metres},$$

as mean acceleration and retardation of sound, and of the atmosphere through its whole height by wind. It is—

$$347 \text{ m.} - 51 \text{ m.} : 347 \text{ m.} + 51 \text{ m.} = 1 : 1{\cdot}37$$

as the oscillations of the magnetic needle within the mean of the two regions of intensity, the mean of the minima to that of the maxima of magnetic intensity being $1 : 1{\cdot}37^2$.

The apparent irregularities in this system of compensations corresponding to 1 ÷ 59·56, the eccentricity of the orbit of the earth, or the mean tension of all ascending vapour against the weight of the atmosphere, or to—

$$1 \div 59{\cdot}56^2 = 1 \div 3546$$

the mass of the sea to that of the earth, &c.

The compressibility of water at 15·22° C. by one atmosphere being 0·0000464, the velocity of sound in water is, according to Laplace's $\sqrt{g \div \lambda}$, equal 1454 metres.

The earth below the atmosphere and sea is a solid, with an intervenient more or less liquid stratum, in the mean 5·45 times more dense than the salt sea. Attraction within changes with distribution of density and depth. The change in solar distance is—

$$1 \div 29{\cdot}78 \text{ ; it is } \sqrt{29{\cdot}78} = 5{\cdot}45 :$$

when we assume as probable that the mean of compressibility of the substances composing the earth is under pressure of one atmosphere 1 ÷ 29·78 of that of water, considering differences of temperature, o. s. p. as 1 ÷ 29·78, is the percentage of water-stuff in the air or of salt in the sea, the velocity of sound for the mean earth will be 5·45 times that in water, or $1454 \text{ m.} \times 5{\cdot}45 = 7933$ metres.

The velocity of a point at the equator in daily rotation is 457 metres, and its centrifugality is 1÷289 of gravity. A tangential velocity of $457 \text{ m.} \times \sqrt{289} = 7933$ metres, or that of sound in the mean solid would make any particle all over the earth absolutely centrifugal if the pressure of the atmosphere and sea, and adhesion and cohesion of molecules in and amongst each other, the centrifugal opposition and the co-attraction of the sun, o. s. p., did not turn projection into vibration. All sound carried to the centre of the earth is neutralised by a counter-vibration from the opposite side.

The compressibility of ocean water at its mean temperature is 1÷12·08 (the proportion of the polar zones to the sphere) less than that of water at 20° C. (the mean temperature of the surface layer of the sea), or only—

$$0{\cdot}0000417 = 1 \div 23730$$

of the depth of the ocean, which is also the proportion of the radius of the earth to the mean solar distance. The compressibility of the ocean by the atmosphere stands thus in a simple relation to the elliptic and polar motions of the earth, and to the elastic reactions of land, shell, and intervenient stratum, in an opposite sense to those atmospheric changes for which the sea originally furnishes the material.

When sound is collected and levelled by the tympane of the photophone, and entrusted to beams of light and radiant heat, centralised by a lens, the air-waves produced by our breath are transferred from the general atmosphere to the atmospheres and bodies of molecules, and re-transferred to the receiver again magnified from molecular to terrestrian dimensions.

When, in the telephone, electric and magnetic motions are substituted for plain light and heat motions of the photophone, the difference is one of inter- and intra-molecular motions. The again enlarged sound-waves are delivered to and re-centralised and insulated by the ear-tube, which transmits the message of the outer world to the molecular electric conduction of the acoustic nerve for conveyance to the brain,—the camera where we store and arrange, to the degree of its capacity, all phonographs and photographs by which we refract, reflect and concentrate, diffuse and absorb the intelligence of the infinite.

" La différence qui existe entre les sons graves et les sons aigus est si frappante pour nos organes qu'elle doit certainement correspondre a quelque modification physique bien caractéristique dans l'air qui porte les sons," said Pouillet, without fathoming his thought to its full depth. The deepest audible wave has in the mean state of the atmosphere a length of 10·36 metres, which is that of a column of water equal in weight to the whole atmosphere pressing on us. The highest audible sound-wave is 31 m.m., the 1 ÷ 333 of the deepest, 1 ÷ 333 being the mean centrifugality of the earth, and the mass of the atmosphere to that one of the sea, o. s. p.

Sound is not transferable through vacuum. The waves of matter to be audible must be of a certain size, which is directly obtained only by the mass motion of matter against coherent or contiguous matter. The vibrations of a tuning-fork within a vacuum are inaudible, yet they put the bell around in vibration, for they are seen.

The denser a medium at equal elasticity, or the more elastic at equal density, the more rapidly it carries sound. But when sound is carried by light it travels still more rapidly, and yet it shall then be carried by a luminiferous ether infinitely less dense than our atmosphere.

The emission, as well as the undulation, theory has occasionally predicted observations, for truth may be disguised in myths. The propagation of light does not require what we do not know, but atoms about which we know a little. Whereas Newton left it "to the consideration of the reader if his agent," leading matter according to the law of gravity, "be material or immaterial"; the apostles of ether now call it matter. If it be matter in any state the propagation of light should, like that of sound, be connected with the *g* of the earth. Yet light is said to travel uniformly across the orbit of the earth from the moons of Jupiter and the most distant stars, and from any generator to any receiver whatsoever, unless within our atmosphere. Yet attraction vastly decreases through these spaces, and depends on mass. The velocity of light should also be influenced by the *g* of the mass from which it starts. The density of ether—indifferent if it be gaseous, liquid, or solid—could not be uniform between the generator and receiver of light.

According to some the ether is an undivided rigid solid. How could it undulate, having no internal elasticity, no space for motion? how could it be pierced regardless of the propelling and resisting force, according to the theory of emission?

The velocity of sound is measured by elasticity of tangible matter; but who shall measure the elasticity of what nobody ever felt, saw, and caught, or intelligibly described?

According to others ether is a contiguous liquid, moving with "infinite" rapidity in vortices within bounded spaces, now carrying all sorts of matter along, now passing through it, now surrounding it through vastest spaces with undensest density, now jammed and compressed between its molecules.

The liquid shall, revolving in closed spaces or in a finite universe, become an absolutely rigid liquid. A number of entertaining experiments shall even prove this stupendous theory. A bounded universe within infinity is an absurdity;

and what gives rigidity to a whirling liquid within a bounded space but centrifugality reflected, which is the outcome of centripetality, of plain matter? Centrifugality cannot produce an effect greater than its cause: a liquid at the limit of absolute rigidity by vortex motion would either break its boundaries or destroy its own motion, collapse; and centripetality, and consequent polarity, would be re-established by increase of density of the one part, and creation of a vacuum of the other, inside a bounded space.

Can one not see that a gas, a liquid, a solid, anything having no interstices,—that is, no inner surfaces, no disparities of inner motion, but filling all space with uniformity,—is nothing?

I ask the thoughtful amongst the professors of the infallible creed, with all its sectarianisms, Is there anything more difficult of conception and explanation in action at a distance than in the existence of matter? Any least volume taken as a sphere, not moving, as a nucleus, a point, surrounded by one or more concentric strata of least thickness, is absolutely contiguous matter when the difference of attraction from an interior to the next exterior stratum or surface is less than the difference in excess of size of the exterior over the interior surface, which may represent as well a decrease as an increase of attraction toward the centre of the whole space or volume; but when equality is reached attraction towards this common centre simply increases with the size of the surrounding concentric surfaces, which then represent vacuum. There is no difference between matter and vacuum, but an addition of force with additional space, which may be as well a relative gain as loss of force in proportion to increasing surface of attracting volume, and an absolute subtraction of attracting force equal to the increase of the attracting surface.

If matter was absolutely contiguous, without separating absolute vacuum, if there were no action at a distance there could be no matter; it had to crush itself out of existence to result in absolute rest which—for us finite beings and brains inconceivable like infinity—yet is; vacuum furnishes the possibility of extending motion, which, together with attracting motion, is the existence of something.

We know of light only because we have an organ constructed to make us aware of it. Light appears only where there is matter thus moved that it enlightens our eye. Issuing from matter, radiating all round, light spreads in equal matter in equal manner, and in different matter in different manner with decreasing intensity, or is partly or wholly reflected by opposing matter.

When we hold an opaque object before a flame it disappears, but we see the air, matter, illuminated to the sides of the shadow. When our side of the earth is away from the sun, and the refraction of light by our limited atmosphere no longer carries it to us, when the attraction of the earth no longer finds matter productive of light, the light of the sun disappears until it meets matter, which reflects on us the motion directly received from the sun.

If all space were filled with matter, indifferently how we call it, we ought to see all space illuminated outside the shadow of our earth. When the tail of a comet is matter so attenuated that we see beyond it stars with undiminished splendour, it is visible because the motion communicated to single particles by the sun is transferred by their motion to the earth.

With the ether hypothesis, bridging a chasm by a word, the imaginary only in the undulatory theory falls.

There was a time when heat was a fluid accumulating round molecules; now few physicists will deny that it is a motion of the molecules. Why, then, appeal to phantoms when it comes to light? The apparently uniform velocity of light in space, which great, is not instantaneous, as action at a distance might be supposed to be, and prime gravity is, disturbs the mind. But is not radiant heat the rapid companion of light? Is not sound made the companion of both? Do the ethereans furnish any reasons for this great and uniform velocity of light travelling through the heavens? And if they cannot, what is the value of the idol which does not lead them out of their perplexities?

Light and radiant heat shall be propagated in straight lines, whereas other forms of energy follow the sinuosities of conducting substances. But even this distinction is illusory; the beam of light is not merely refracted and reflected, but also diffracted, bent, and divided.

The smallest, like the largest, portion of matter is an individuality; it has in itself a distribution of force, according to its past and present relations to other individualities which lead to various inward and outward motions.

Examining the nature of these motions, the condition for the existence of matter is attraction; without it, no matter. The consequence of attraction is repulsion, which may be rectilinear and re-destructive, or curvilinear, rotary, and orbital. Matter has temperature depending on its relations to other matter; vacuum has no temperature, but volume, depending—in its definite or indefinite limitations—on the mass, volume, and motions of matter.

There is no light without heat, but there is heat without light. I have defined heat as the rotary motion or tendency of masses and smallest particles, themselves having their density unequally distributed in them, and light as their orbital motion, dividing in waves. There is no light, only heat,—dark light.—when the orbital progressive motion falls entirely within the individual, when the transport of its centre of force in space is less than the mean velocity by rotary motion of any point of the outer surface of the particle, or aggregation of particles.

Emission and undulation theories are not irreconcilable. To see this we need not discuss the "material or immaterial agent," or the ponderable or imponderable ether, or my rejection of either. "One distinguishes two general kinds of motion essentially different, the translatory and the vibratory." "The former is the basis of the system of emission, the latter of that of undulation of light." This distinction merely indicates differences produced, in equal results from equal causes, by the variety of extraneous circumstances in which they are placed and under which they occur. Both motions are due to an attraction and repulsion of one mass by another, both these effects being convertible into each other. The difference consists in the rapid succession of reversions, and the contact or approximate contact of the individual masses and particles.

Matter from space, meteors of all sizes and kinds join the earth, and a regular interchange of mass exists within the solar system, and more or less between systems. We may therefore advance in favour of the emission theory the hypothesis that Crookes's corpuscles are propelled from the sun and stars with the velocity of light towards the earth, attracted, directed, and concentrated by her through a polar interaction of projector and receiver, without there being any need for a fourth state of matter of which we have no concept.

I call the action polar because it cannot exist outside the profiles of projector and receiver, without whose attraction the centrifugal energy of the projector, or particles of his, would not acquire the trajectory surplus necessary to start particles away from its own re-attraction and polar action, the mutual attraction and energy between both masses being zero outside the cones connecting the semi-surfaces of generator and receiver, in so far as there is no third centre of force affecting both.

Striking the atmosphere, meeting with resistance, the gradually penetrating projectiles produce light and radiant heat, which are propagated by the mass struck as waves, as vibrations. When light stops reflected or absorbed, as all become radiant heat, this heat turns, gradually advancing, into conducted heat.

Further, supposing that planets and moons project out of their comparative darkness by corresponding causes, under the far more powerful attraction of the sun, a return current of particles with velocities far exceeding that of the particles moving against them, they maintain the lighting and heating process and power of that centre.

I shall not detain the reader with the proof that the hypothesis is not admissible.

Light and heat arise from changes of frictional and chemical character in masses and molecules,* the resulting motions inducing, by way of gravity, corresponding motions not only in adjoining bodies, but also through vacuum, at a distance, in molecules and masses.

The increase of heat and the following generation of light will always consist in an increase of molecular centrifugality somewhere, compensated by contraries elsewhere. All changes of temperature and production of light are therefore inter- and en-molecular motion.

The sun overrules all light and heat processes within its system. It yields light to its own and other systems; it induces in its planetary following a harmonic motion and life. It generates heat and light by alternate composition and decomposition of atoms and molecules embraced in a progressive combination, metamorphosis, and condensation from constitution to re-dissolution, from birth to death; this process in its generality being induced by planetary motion round the sun, and with the sun in its orbit, not without reciprocity with other systems.

When stellar, solar, or terrestrian molecules experience by any cause an elevation of centrifugality, wholly or in portions of them, we feel the propagation of such motion as heat, and when the increase is of a certain amount, and results in a trajectory, we see it as light. Not only the light spending portion of such molecule gets more or less removed from its centre of force, but the whole molecule is moved from the centre of the portion of mass, or of the mass to which it belongs; it tends instantaneously to absolute centrifugality, to be in the next instant repelled by a distant mass and by its neighbour molecules, whose centrifugality and consequent counteraction it increases with regard to the centre of its own mass; it propagates light wherever it meets with resistance, with matter which has to accommodate itself to the polar and multipolar motions of molecules, to their inter- and en-molecular axes, faces, and stratifications, and finally turns to heat entirely absorbed.

---

* My views on adhesion, cohesion, and chemistry are chiefly contained in "Heat and the Atom," "The Origin of Organisms" (1859), &c.

Be S the sun; *a*, an atom of his involved in a light generating combination, repelling it from S; *c*, a molecule of a satellite, L, of Jupiter turned towards *a*, and not separated from it by opaque masses; and *b*, an atom of the earth turned towards *c* : *a*, in itself a microcosmos, is repelled from S and brought nearer *c*; it is therefore more attracted by L than the mean S, and therefore next exercises an increased repelling and frictional influence against *c*, which thus repels and presses interior molecules, *f*, towards the centre of L; *c* describes an orbit towards the centre of L. This motion puts to greater rotation the more resisting, denser *f*, which, thus induced to greater rotary motion, renders only part of the acquired orbital motion as reflected motion, as light towards *b*. But all this transmission of orbital motion of waves, this propagation of light and radiant heat, requires time,—a completed circuit of coming and going motion between whole strata of generator and receiver.

Sound does not reach, like light and heat, through space; it is not heard through vacuum, but it can be more or less communicated by any matter contiguous or made contiguous. The spaces dividing heavenly bodies are therefore empty spaces; even light and radiant heat carry no message from them to our ear, but they carry it through our atmosphere.

Sound is the result of a propulsion and repulsion originated by that attraction which puts the striking body in motion. The amount and quality of shock, and the qualities of generator and receiver, determine the qualities of sound; thus the distance, power, and qualities of generator and receiver of light and heat determine their quantities and qualities.

The velocity of sound does not depend on the shock which produces it, but on the medium in which it is propagated; any over motion, for instance by wind, being a transport of the medium itself with its vibrations, or a mutation from sound to silent different motion, again mutated to sound. The velocities of light and radiant heat also depend on qualities of the medium in which they travel, and most media even exclude the propagation unless reduced to less than a contiguous film, or to the gaseous state. Why, then, is it that light and radiant heat seem to use time in proportion to the vacuum distance separating heavenly bodies, the resistance being zero? Because vacuum is in its dimensions determined by the interaction of aggregated masses of matter, of generator and receiver. Vacuum is a medium having the quality, distance, rectilinear dimension (no other), transverse undulation, cross section of orbits, making the orbits' waves only existing where there is matter.

We know of sound only because we have an organ which has adapted itself to its reception and valuation, and I showed the motions producing sound in definite relations with the inorganic earth and with the grouping of its chief sections. As we also have an organ so developed and constructed as to feel and value light, and our whole body is made dependent on heat, we may well assume that the motions constituting light and heat stand in similar relations to the mass, structure, and motions of the earth.

Any particle is subject to the common attraction and repulsion by the earth; it is next subject in common with the earth, and again as individual, to the differentiating attraction and repulsion by the sun; and it is further subject to the attraction and repulsion by other bodies, molecules, and atoms, non-terrestrian and terrestrian, themselves having their special centres and internal distribution of force.

The earth is a solar particle separated by vacuum from the sun and other heavenly bodies; it is out of equilibrium with regard to the central mass. This constitutes differences in the light received by the earth from without, and generated within its limits, where the origin is entirely surrounded by neighbours coming in contact with it.

The sun is the immediate ruler of the earth. Any terrestrian molecule entering on the motion light, indifferently if received from outside or inside the earth, is for an instant subjected to a tendency of absolute centrifugality from the earth, immediately reacted against; it is therefore an object in contention between the centrifugalities and attractions of sun and earth, all third disturbing parties and light generators being subordinate to their leading contest among themselves.

There are solids more or less penetrated by light and radiant heat, themselves similar, yet distinct in action, the difference being orbital and rotary motion, one passing into the other as arrested transport into accelerated rotation, and arrested rotation into accelerated transport. Of these solids none but solid water is of any frequency, and all but ice are so hid away in the general solid that we may well say light and even radiant heat are absolutely reflected by the solid earth; they do not penetrate except as conducted heat, with vibrations whose axes are less than the mean radii of the molecules.

Even liquids, the leading one again being water, are as often an obstacle as a medium for their propagation; undulation and actual transport get confounded. The true medium for light and radiant heat, making them two in one, is vacuum, in which they are zero, distance, and matter in the form of gas, and foremost that great mass of gases we call the air, the atmosphere itself being—by its ascending vapour of water—a still more rapid, or the real, propagator, and by its water, in the form of vesicles, drops, solids, and vapour in absorption, an obstacle to the rapidity and effectiveness of propagation of light and radiant heat.

That relative quantities now to be used, and described in this causation in "On some Properties of the Earth," have been obtained without any regard to sound and light, but with reference to gravity and heat, is in favour of their correctness and of my views.

We have to consider the limited earth as an individual of a certain mass, density, shape, and inner distribution of force, *i.e.*, matter; and any planet, moon, comet, and meteor, and any star and nebula exchanging light and heat with the solar system, as another individual. Such individual is, in the vacuum of the heavens, a medium for the propagation of outside and inside light and heat, consisting itself of various media. And as the velocity of light is not the same in different media, it will, without time in vacuo, not act beyond vacuum in equal time on those individuals; and even with regard to the same individual, indifferently from where it is generated, or reflected and re-transmitted, the time which elapses before it becomes sensible for the receiver will depend on the rectilinear interaction of the generator and receiver, or on their distance and change in distance.

The ear is a terrestrian organ; it finished with the velocity of absolute centrifugality of a particle of the earth: the eye is a solar terrestrian organ, and this velocity enters as a first term in the velocity of light; it is the velocity of resistance to solar differentiation and induction, productive of light within the medium earth; and as with the earth so with other bodies, and with any particle according to its microcosmos.

Light cannot be generated where there is no atmosphere and no liquidity from which it is developed, no actual molecular transport; it can at best be reflected, and re-transmitted, and even then the solid molecules reacting upon outside matter as re-transmitters of light must assume a centrifugal tendency, developing a molecular atmosphere and sea, &c.

When any particle is on the side towards the sun, and the latter, then acting negatively on it, gives it alone, or in common with other heavenly bodies or purely terrestrian molecular combinations, all under solar supremacy, the tendency is towards the velocity $\sqrt{gr}$ of absolute centrifugality; this tendency increasing molecular rotation, heat, opposed to plain gravity, g, will move it from west to east. Immediately after, however, the particle lifted towards the sun, made more solar, receives a tendency to an accelerated motion in an orbit round the sun from east to west, to a velocity greater than the mean one, B, of the whole earth in her orbit round the sun, and therefore in advance of the earth, and opposed in direction to the tendency $\sqrt{gr}$ of the particle. Terrestrian and solar centrifugality at once reacting, the former against solar attraction and lifting, the latter against terrestrian centrifugality moving the particle away from the sun in front of the earth, or so tending, and actual transport of the particle being thus prevented, there will be vibration only according to the qualities of the stratum of which the particle forms part, and the qualities of the particles and of the enclosing and underlying strata, the resistance of less elastic against more elastic molecules. All the qualities of strata will possess certain respective proportionalities as long as the contiguity of the terrestrian mass is not entirely destroyed,—as we may observe it with comets when they are dispersed into nebula and split into separate masses.

When the particle is on the side of the earth away from the sun, and therefore receives the tendency towards the velocity $\sqrt{gr}$ only by reflected light (action), or by own light from third bodies outside or inside the limits of the atmosphere, the tendency will still be in the sense of rotation of the earth, but east to west, and the particle lifted from the earth will have the tendency to slacken its motion round the sun, and to stay behind the mean motion, B, of the earth round the sun. Earth and sun, however, now combining in re-attracting the particle towards the earth, the mass of both being more or less between the particle and the sun, there will be again an opposite tendency of motion of the confined particle, a wave motion, propagating the impression from the respective light generator. We may therefore say, *in a general way*, the censed velocity of light *in vacuo* will, with regard to any insulated mass within the solar system, depend on the radius of the receiver into solar distance, indifferent if the inducer of light is in or out of the system; this quotient being subject to change when the body is unconstituted, like a comet which expands indefinitely and breaks up in individual masses.

When we, then, naturally ask, What is solar distance, which varies? what is the radius of the earth? does it include the height of the atmosphere and the mean depth of the moving sea, or the mean depth of sea and land raised, or neither? we perceive at once that the first relation given is, indeed, a general way, and that the censed velocity of light depends essentially on the receiver, without being independent from the generator, and its system, ruling all other generators and reflectors with regard to our observatory, the earth. We may comprehend that fully by putting to us the further question, How could we receive an image, how could we chemically impress it in a photograph, if the general, the sectional, and the (in themselves) microcosmical molecular masses did not exact on us distinct impressions of their individual existence and motions?

We would be, indeed, at a loss to make anything of the velocity of light if our earth were not so permanently constituted, for the time being, with regard to the outside world, and especially the sun, as our sound eye is,—a colour-blind unsound eye combining either exceptional wave-lengths or exceptional velocites, and therewith incorrect numbers of vibrations. The eye is, in the mean of the indices of refraction of its parts, identical with that of water; and salt water, the atmosphere of the earth, is that of the eye, which so corresponds in its characteristics to sea and land.

The atmosphere, the real home of light and radiant heat, is the distinct stratum at the limit of which begins the action of light and radiant heat.

I showed the air—the elastic, gaseous, dielectric cushion round the earth—to be the centrifugal outflow of the sea, its $1 \div 333$ in mass, as much as the mean centrifugality is of the mean attraction of the earth. I showed that the vapour ascending from sea and land against the pressing air, turning it into atmosphere, is $1 \div 59{\cdot}56$ of the mass of the atmosphere, and that all the water-stuff ascending, and again descending as vesicles, drops, crystals, and absorbed vapour, at any time suspended in the air being—

$$1 \div 59{\cdot}56 \times 2 = 1 \div 29{\cdot}78 \text{ of the atmosphere,}$$

represents the solar disturbance in the stratum air, this water-stuff, all originating from the sea, being lifted and carried in orbits through the air by the differentiating power of the sun.

I showed that the atmosphere is on the day-side by the reaction of solar centrifugality and terrestrian attraction against solar attraction and terrestrian centrifugality, and on the night-side by the joint attraction of sun and earth against the centrifugal tendencies of the earth confined within a definite boundary by an outer atmosphere.

The ascending vapour, the 1÷(333 × 59·56) of the mass of the sea, is thus confined between a gaseous skin and a liquid and solid stratum. Circulating in the air the water-stuff, with its varying forms, becomes the conveyer and distributor, the propagator and the obstacle, of light and radiant heat in the atmosphere,—that is, of the action of the mass, atmosphere, and molecules of the sun, &c., on the mass and molecules of the outside earth.

We thus have the initial or vacuum velocity of light at the outside limit of the atmosphere, B representing the mean velocity of the earth in her orbit round the sun.

Formula *a* :—

$$\sqrt{(\sqrt{gr} \times \mathrm{B})} \div (1 \div 333 \times 1 \div 59{\cdot}56) = \sqrt{(\sqrt{gr} \times \mathrm{B})} \times (333 \times 59{\cdot}56)$$

= A, the velocity of light in a second = 305,686,092 metre.

Do the following coincidences not offer a strong probability in favour of my reasoning? I showed (o. s. p.) that the fresh sea is 1÷3546, and the salt sea 1÷3426, of the mass of the earth, and that the earth has in either sense, equatorial and polar, apart of the flattening, an excentricity of 1÷3546. Observation gives the index of refraction of air at 0° C., under 760 m.m. pressure, 1·000294; when we take the air with the water-stuff and the 15·22° C. it is—

$$1 \div 3426 = 0{\cdot}000294,$$

the 1÷3546 giving = 0·000282.

(To be continued.)

II. THE POISONING CASES OF THE LAST HALF-CENTURY.*

THE stories of Tawell, of Palmer, of Dove, of Madeline Smith, which in their turn filled the columns of the press and set in action the tongues of half the kingdom, have not yet lost all their meaning. If we carefully read the book before us, we may see that it contains lessons of importance not merely to lawyers and physicians, but to much wider circles. The moralist may, for instance, be painfully struck with the startling cross-lights which a great crime throws upon society, and with the strange revelations which they bring. How many persons in the little town of Rugeley, besides Palmer, moved in the light of respectability, perhaps even in the odour of sanctity, until the trial of 1856 enabled us to look behind the scenes!

A much more important consideration, from our point of view, is that the heroes of the poisoning cases before us belonged, almost without exception, to the so-called respectable classes. Their previous conduct had not, indeed, been morally free from reproach, and several of them had been concerned in doubtful transactions. But they were not habitual criminals; they were not the companions of criminals, and they could not rank in that order of men who are "well-known to the police," and who are apt to be suspected in case of any untraced crime. One of them, indeed, could and did say "My station in society places me beyond suspicion!"

This point naturally brings us to the question of their education. Of the thirteen persons who have thus been placed before the tribunals on the charge of murder in so cold-blooded and treacherous a mode, four were members of a learned profession; none, probably, were grossly ignorant, and none had in their early life been brought up in oblivion of the distinction between right and wrong, or systematically trained to a general warfare against society.

These facts, surely, are not without bearing upon the moral and social influence of education, and the benefits to be hoped from its universal extension.

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* Reports of Trials for Murder by Poisoning with Prussic Acid, Strychnia, Antimony, Arsenic, and Aconita, including the Trials of Tawell, Palmer, Dove, Madeline Smith, Dr. Pritchard, Smethurst, and Dr. Lamson, with a Chemical Introduction and Notes on the Poisons used. By G. LATHOM BROWNE, Barrister-at-Law, and C. G. STEWART, Senior Assistant in the Laboratory of St. Thomas's Hospital. London: Stevens and Sons.

The question of heredity here naturally occurs. Had crime or notorious vice existed in the families of these evildoers; and were they what they became by the right of descent? On this most important point the trials throw no light. Thus concerning the parentage and ancestry of Tawell we learn nothing. About Palmer authorities are almost equally silent, and the same may be said as regards the other persons convicted. To obtain the needful information might now be difficult, and it is quite possible that its publication, if obtained, might prove a very costly luxury. We can only, speaking from a physiological and psychological point of view, suggest that in case of all notorious criminals the career of their ascending and collateral relatives should be traced out and put on record as a sequel to the trial. Concerning the genesis and the propagation of crime more abundant and more accurate data are wanting, before it will be possible to theorise with acceptance and success.

Leaving, however, all the above-mentioned matters to be discussed elsewhere and by others, we come to the main consideration, How does our modern chemical and medical science stand affected by the trials here recorded? Have any doubts touching its competence arisen, either in the mind of the public, of the legal profession, or in that of men of Science themselves? In other terms it may be asked—

1. Have we at command means for the detection of all known poisons under all circumstances?
2. Have our leading toxicologists and physicians shown sufficient skill in the application of such means?
3. Is our manner of conducting criminal trials, and of obtaining and dealing with the evidence of experts, well adapted for the discovery of truth and for the elimination of error, or could it admit of useful modification?

Before attempting to discuss any of these questions we must make the preliminary admission that not all poisons are known. Many natural productions, and still more artificial compounds, have not in this respect been even approximately studied, and in England, at least, such re-researches are now rendered almost impossible. We dare not even affirm that all existing types of poisons are known. Indeed from time to time reports reach us of substances which in their action simulate malignant fever. Leaving all such considerations aside, as not immediately apposite, let us take up the first question, and reply with an emphatic "No!"

Aconitine is an instance in point. We may judge that it has been taken by the symptoms which it produces, and by physiological tests which the operator applies to himself or to other animals. But true chemical reactions, precise and available, it does not exhibit. We may extract it from the remains of the deceased, and obtain it, freed from all other substances, in a state of purity; but when this is done we cannot give a chemical or physical fact in answer to the question, "How do you know that this particle of matter which you produce in the watch-glass *is* aconitine?" The microscope, the spectroscope, the polariscope, which have solved so many problems, are here silent. Colour-tests have been proposed, but a doubt hangs over them all, and in some cases the reaction described would seem due not to the aconitine itself, but to some impurity, which may or may not be present. Hence they are of no scientific value.

We may next turn to the ptomaines. Recent researches have made known the existence of a class of alkaloids or organic bases which are generated in the body during putrefaction, during morbid conditions prior to death, and even, it is said, during normal healthy life. Concerning these cadaveric alkaloids we know, as yet, sadly little. We cannot state their number, nor lay down their physiological action, the circumstances under which they originate, and the reactions by which they may be recognised. Some of them resemble strychnine in their action upon the human system, and in certain of their chemical reactions. Indeed, in the work before us, mention is made of a case where an Italian toxicologist, F. Ciotto, pronounced strychnine to be present in a dead body, whilst Prof. Salmi, one of the chief investigators of the ptomaines, being called for the defence, showed that the substance in question differed in some of its properties from strychnine, and was probably one of the ptomaines. Some time ago it was asserted that the ptomaines might, as a class, be readily distinguished from the natural vegetable bases by their property of reducing potassium ferri-cyanide to ferro-cyanide, and thus giving a blue precipitate with ferric salts. But some of the vegetable bases—among others *aconitine*—produce the very same reaction, though more slowly. Hence the class distinction is broken down, and all that can be done is, as the authors of the work before us suggest, to depend upon the fact that there is no ptomaine known which produces *all* the characteristic reactions of morphine, aconitine, &c. But this is by no means a satisfactory state of things, and an immensity of delicate and difficult work will be needed before we can reach actual certainty.

It is manifest, as was actually shown in Lamson's case, that the existence of these ptomaines suggests a new and plausible line of defence, of which counsel will not be slow to avail themselves. But there is a further point as yet overlooked. A physician, or a chemist, or a man tolerably skilled in experimentation, may prepare some of the ptomaines from animal matter, and may administer them to any person he wishes to destroy. How is his crime to be detected? Suppose the ptomaine is found in the corpse of the victim; the defence at once admits its presence, and argues that it must have been formed there either prior to or after death. The prosecution will certainly fail to prove to the contrary.

But coming down to much less difficult subjects, we find in the statements of the experts engaged in these trials, and in the authorities quoted in this work, a manifest lack of that agreement which must follow from accurate knowledge. Let us take the question, How long after death can hydrocyanic acid, administered just previously, be recognised? Mr. Allen affirms that its detection is rarely possible after twenty-four hours. On the other hand, "Casper obtained from a corpse more than 18 milligrammes eight days after death; Sokoloff detected it in hounds sixty days after; Dragendorff after four weeks in a dog, after eight or ten days in a man. Reichardt found it in a body two months after death—in the solids, though not in the urine."

In the Tawell trial the odour of hydrocyanic (prussic) acid seems to have occasioned much wrangling, and many conflicting opinions were given. Counsel asks Mr. Cooper, "Do you agree with Dr. Taylor that the odour of prussic acid may be found when all tests fail?" Mr. Cooper replied, "I have no doubt that prussic acid may exist without being smelt." Mr. Norblad, a surgeon and apothecary, of Slough, further deposed that he had tried experiments with this poison upon dogs, and on opening their bodies eighteen hours after death could not discover any odour. He had further mixed 12 grains of prussic acid with a pint of porter, and could not smell it. On the other hand, one Henry Thomas, a druggist's shopman, whose claims to rank as a man of Science may possibly be called in question, did not think porter would disguise the odour. He had mixed 30 drops of this acid with 11 ounces of porter, and the smell was "slightly perceptible." On another occasion he had put 20 drops of the acid down the throat of a parrot, with a glass syringe, and the smell was so suffocating that three women who were present had to leave the room! On opening the body of the woman poisoned by Tawell, Mr. Champneys positively smelt prussic acid, whilst the other two surgeons present could not. In a case of suicide by potassium cyanide (*see* "Chemical News," 1861, p. 261) the smell of prussic acid was not perceived by the surgeon during the *post mortem*, nor by the chemist during the analysis, until the contents of the stomach had been distilled with dilute sulphuric acid. In experiments made by the author a poisonous dose could be distinctly smelt in 1½ pints of stout.

Now making all due allowance for the great difference in the sense of smell in different persons, for its want of constancy in the same person, and for the admitted variation in the strength of commercial samples of prussic acid, it may still be urged that there is here an undesirable want of agreement on a simple matter of fact.

We pass next to strychnia. In the Palmer case Dr. Taylor failed, as is well known, to detect this poison in the body of Cook. Commenting on this result Mr. Herapath said, in his examination, "If it had existed in the body of Cook it ought to have been discovered,"—"if it was there Dr. Taylor ought to have found it," and he would not deny having even said "No doubt strychnia had been given." On the other hand, Dr. Taylor denied that strychnia could always be found when it had occasioned death.

A further difference of opinion took place as regards the persistence or the transformation of strychnine in the body. The late Dr. F. C. Calvert succeeded in extracting strychnine from the bodies of some hounds three weeks after their death. Mr. Nunneley, without pronouncing strychnine absolutely indestructible, maintained that within ordinary limits it could be found unchanged, even forty days after death. Richter has even detected it in animal tissues *after eleven years*. On the other hand, Mr. Morley leans to the opinion that the poison, having done its work, ceases to exist as such. Dr. Taylor, too, holds that it "undergoes some partial change in the blood." Dr. Taylor, at this memorable trial, even committed himself to the statement that "the colour tests [for strychnine] are fallacious," whilst they are now recognised as decisive if the known precautions are observed. The same eminent toxicologist declared that he knew of "no process by which strychnine could be detected in the tissues." This has been repeatedly done, as Dr. Taylor has since admitted.

In summing up all that has preceded we must remember that the art of toxicology has made rapid strides since the trials of Tawell and Palmer, but that scope for improvement still exists.

Turning for a moment to the strictly medical evidence given, in which the cause of death is inferred from the symptoms before death and the appearances afterwards presented, we find an amount of discrepancy, and even antagonism, which is positively painful. If we confine ourselves to Palmer's trial we find the death of Cook successively ascribed to poisoning by antimony, to tetanus (traumatic or idiopathic), to apoplexy, epilepsy, to convulsions with tetanic complications, to angina pectoris, and to the effects of morphia. These varied hypotheses, brought forward by persons who could judge only by hearsay, elicited from counsel on both sides in turn most severe comments. Said the Attorney-General (Sir A. Cockburn), in his reply to the defence in Palmer's case, "To me it seems a scandal upon a learned, distinguished, and liberal profession that men should put forward such speculations as these, perverting facts and drawing from them sophistical and unwarrantable conclusions, with the view of deceiving a jury. I have the greatest respect for Science,—no man can have more,—but I cannot repress my indignation and abhorrence when I see it thus perverted and prostituted to the purposes of a particular cause in a court of justice." Again, with reference to the suggestion that Cook had died of *angina pectoris*, he speaks of the "ignorance or presumption" of the witness in question. "I say ignorance or presumption, or, what is worse, an intention to deceive." One more quotation will suffice :—"I abhor the traffic in testimony to which, I regret to say, men of Science sometimes permit themselves to condescend."

It is, indeed, deeply to be deplored that the slightest room should have been given for comments such as these. The effects of such denunciations, and of the exhibitions by which they were called forth, have even yet not entirely disappeared. But did counsel and judges ever ask themselves what lies at the root of the party-feeling and the unscrupulousness thus complained of? Of this hereafter.

We have yet to inquire whether the analytical chemists engaged in these poisoning cases employed all the known precautions for eliminating error, and whether, again, they observed that discretion which a respect for public justice, for their own professional honour, and for Science should dictate? To neither of these questions can we reply in the affirmative.

We refer here to the admission of no less distinguished a chemist than Prof. Brande, that in applying Reinsch's test for arsenic he generally used a halfpenny rolled down as "pure enough for the purpose." Dr. Taylor, also, seems for twenty years to have used untested and possibly arseniferous copper for the same test. Dr. Herapath, even, in a letter to the "Times" in reference to Dr. Smethurst's case, though not written until after his conviction, pronounced the whole set of operations in that case a "bungle." "Taylor must have known that Reinsch's test was inapplicable in presence of nitrates or chlorates." Leaving these instances of something closely bordering upon carelessness, we cannot close our eyes to the personalities contained in Herapath's comments on Taylor,—strictures so unworthy of a gentleman and a man of Science that we could almost suspect some old grievance to have existed between the two. The verbal communications made by Dr. Taylor to one Mr. Augustus Mayhew, of the "Illustrated Times," who succeeded in "interviewing" him, professing to be employed by some insurance company, were, to say the least, highly indiscreet, and became unpleasantly notorious. Nor did Dr. Taylor's subsequent letter to the "Lancet" greatly improve his position. It contained a passage from which counsel sought to extract the meaning that the conviction of Palmer was necessary for the public welfare.

We now come to our last question, and ask whether the English method of dealing with the testimony of experts is well adapted for eliciting the truth and eliminating errors due to possible ignorance, carelessness, or bias on the part of the witness? Legal authorities, in this country, we believe, uphold the present system, or did at least until quite lately. Thus Mr. Justice Stephen, in his "History of Criminal Law in England," writes, with reference to Palmer's case, "A study of the case will show . . . that the subjection of all the witnesses, and especially the scientific witnesses, to the most rigorous cross-examination is absolutely essential to the trustworthiness of their evidence."

We shall perhaps understand Mr. Justice Stephen's point of view the better if we quote some observations made by him at the Leeds Assizes, late in 1880 or early in 1881. The learned judge is reported to have said that "Leeds was the only town where he never heard those unseemly disputes between the legal and medical professions which occurred constantly at other places. The leaders of the medical profession in the School of Medicine at Leeds had set an admirable example for many years past of truth and candour, and straightforwardness in the witness-box, and he was happy to see that their example was being followed by the younger members of the profession. When a man really tried to tell the truth, the whole truth, and nothing but the truth, in plain and simple language, notwithstanding what consequences might be drawn from it, or whether he was called on one side or the other, bullyings in Court and things of that kind ceased at once." We cannot help feeling, with a correspondent of the "Journal of Science," that in these remarks Mr. Justice Stephen takes a one-sided view of the case, and that, though possibly without such intention, has gravely wronged the medical profession, and other men of Science whose misfortune it may be to have to give evidence in a court of justice. That experts have occasionally been deficient in truth and candour we admit; but we must at the same time maintain that counsel often seek to prevent the truth, the whole truth, and nothing but the truth from being told, if they believe that it may tell against their clients. Instances of this kind may be found in the book before us.

The expert, "called" by one side or the other, is strongly tempted to become a partizan. He holds an anomalous and unrecognised position between that of a witness and an advocate, and unless he be a man of sterling integrity he is tempted to follow the example of counsel by the *suppressio veri* and the *suggestio falsi*. He cannot help knowing that if he contributes in any marked manner to the success of "his side," his reputation and emoluments are increased. Even if he eschews all such considerations, and adheres absolutely to the truth without fear or favour, he is treated by the "opposite side" as a hostile partizan. So unpleasant is this position that it is recognised among men of Science as a difficult task to come out of the witness-box without injury to their credit and without having received insults for which no redress is possible. Hence, among scientific men, the general opinion is that the expert should be the adviser of the Court, not called by either side, and consequently free from all suspicion of partizanship, since acquittal or conviction would be to him alike.

If we glance over Tawell's case we cannot fail to see how much it would have been simplified had Mr. Cooper, as Assessor of the Court, been empowered to dismiss at once as an absurdity Sir Fitzroy Kelly's theory of the prussic acid found in the stomach of the deceased having been derived from apple-pips. In many cases, too, medical or chemical facts would be understood more clearly by the jury if presented to them without the intervention of persons who—as may be seen on careful consideration of the questions in cross-examination—either in reality misunderstand the witness or seek to force a meaning upon his words which he had no intention of conveying.

This consideration ought to impress upon experts in drawing out a report, and authors in writing any book which may be quoted in a court of justice, the necessity of extreme caution. Not only is it necessary to avoid every exaggeration, distortion, or misinterpretation of facts, but every word should be weighed, so that it may neither be honestly misunderstood nor be dishonestly misinterpreted.

III. BENJAMIN FRANKLIN AND THE ORIGIN OF LIGHTNING RODS.

By Colonel A. PARNELL, R.A.

THERE is perhaps no important social subject on which educated persons in general, and scientific educators in particular, have such confused and indefinite conceptions as on the operation of that great natural agency which we in England, and our cousins in America, give the vague meteorological appellation of *lightning*, and our French neighbours designate under the more distinctive and accurate term of *thunderbolts*. The investigation of the action of thunderbolts forms a branch of the study of Terrestrial Electricity, a science that necessarily examines and endeavours to assimilate the nature and functions of all those natural phenomena in which, as the result of patient observation, the force of electricity may reasonably be held to take part. The wonderful, and indeed awe-inspiring, manifestations of thunderbolts, earthquakes, whirlwinds and waterspouts, auroræ, meteors, fireballs, St. Elms's fires, " earth currents," and the earth's magnetism, are thus all elements of this most fascinating, and yet most neglected, portion of Physical Science. The present writer, who, during the last few years, has been able to devote a considerable portion of his leisure time specially to the subject of thunderbolts, and to amass much information in regard to facts and opinions connected therewith, being now engaged in compiling a work on Terrestrial Electricity, has thought that perhaps a few remarks bearing on the relation of Benjamin Franklin to the origin of so-called *lightning conductors*, and arising out of the studies he is pursuing, may be of service in paving the way for a clearer and more definite idea, on the part of interested readers, of the history of these instruments, and of Franklin's original intentions when he introduced them.

Benjamin Franklin was born at Boston, in British North America, in 1706. By trade a printer, his acute and enterprising mind did not permit of this particular calling engrossing his whole attention; for he added to his worldly resources by keeping a shop at Philadelphia for the sale of goods of a variegated nature,—an establishment locally known as a "general store." He appears to have first heard of the new science of electricity at a lecture delivered at Philadelphia by Dr. Spence, in 1746. Franklin was then 40 years of age; but he at once began to investigate the subject for himself, and to make experiments, and it was not long before the same idea that had occurred to Ward in 1708, to Gray in 1729, and to Nollet in 1745, presented itself likewise to his imagination, *viz.*, that lightning was the appearance of an electric spark.

Here, perhaps, we may be allowed to make a slight digression in order to call attention to the confusion constantly made between lightning and electricity,—*i.e.*, between effect and cause. No less an authority than the President of the Society of Telegraph Engineers and Electricians tells us, in his Inaugural Address, delivered in January, 1883, that Franklin, by a bold experiment, "proved that lightning and electricity were one, and consequently obedient to the same laws." In a Lecture delivered at the Royal United Service Institution, on May 6th, 1881, on the same subject, the lecturer said that one of the forms of electricity was "the state of activity (the work-producing state) as in lightning." These *dicta* are in reality tantamount to affirming that a certain portion of the manifestation of the explosion of charge and the charge itself are one and the same thing. A similar derangement of cause and effect is evident also in a paper "On Lightning and Lightning Conductors," read by Mr. W. H. Preece, the well-known electrical engineer, at a meeting of the Society above mentioned, on the 27th November, 1872, in which paper we are told that electricity is one form of energy, and *therefore* necessarily force. Because, in fact, electricity is a certain effect, therefore it must also be the cause of that effect.

Whilst Franklin was pursuing his electrical investigations he kept up a communication with some scientific friends in England who were interested in his researches. His writings at this time consist principally of a series of letters addressed to Mr. Peter Collinson, F.R.S., and they were eventually published under the title of "New Experiments and Observations on Electricity, made at Philadelphia, in America, by Benjamin Franklin, Esq.," the third edition of which was published in London, by Cave, in 1760. Of these famous letters Dr. Joseph Priestley, F.R.S., in his "History of Electricity" (4th edition, London, 1775), says:—"Nothing was ever written upon the subject of electricity which was more generally read and admired in all parts of Europe than these letters. Dr. Franklin's principles bid fair to be handed down to posterity as expressive of the true principles of electricity, just as the Newtonian philosophy is of the true system of Nature in general."

The first letter in which Franklin alludes to the electrical power of *points*, and to the germ of the future lightning rod, is dated September 1st, 1747, and is as follows:—"In my last I informed you that in pursuing our electrical enquiries we had observed some particular phenomena, which we looked upon to be new, and of which I promised to give you some account, tho' I apprehended they might possibly not be new to you, as so many hands are daily employed in electrical experiments on your side of the water, some or other of which would probably hit on the same observations. The first is the wonderful effect of pointed bodies both in *drawing off* and in *throwing off* the electrical fire." [*The italics are Franklin's.*] He goes on to describe an experiment with an iron round shot of 3 or 4 inches in diameter (over which was suspended a small cork ball), and states that, if the shot be electrified, and then a long, slender, sharp, bodkin be presented to it, at some 6 or 8 inches distance, the electricity will be *drawn off* by the bodkin's point. He then says:—"To show that points will *throw off* as well as *draw off* the electrical fire, lay a long sharp needle upon the shot, and you cannot electrise the shot so as to make it repel the cork ball. Or fix a needle to the end of a suspended gun-barrel or iron rod, so as to point beyond it like a little bayonet, and while it remains there the gun-barrel or rod cannot, by applying the tube at the other end, be electrised so as to give a spark, the fire constantly running out silently at the point."

In this letter we have the first intimation of the electrical power of points, and a clear proof that to Franklin is due the great honour of having been the first to introduce the knowledge of this power to the world. On this great fact will Franklin's fame for ever rest, and we shall endeavour to show that it was on this power *alone* that he originally based his invention of the lightning rod. That he actually *discovered* this power is, we are expressly told by Franklin himself, not the case. Dr. Priestley writes :—" Dr. Franklin, in the new edition of his Letters, says that the power of points to throw off the electric fire was communicated to him by his friend Mr. Thomas Hopkinson, who electrised an iron ball 3 or 4 inches in diameter with a needle fastened to it, expecting to draw a stronger spark from the point, as from a kind of focus, but was surprised to find little or none."—(Hist. Elect., 175.) But that Franklin was the original recogniser and employer of this property is acknowledged by Nollet, the eminent French philosopher, who opposed several of Franklin's views, and especially the merits of his lightning rods. According to Priestley, Nollet admits "that Dr. Franklin was the first who showed the property of pointed bodies in drawing off electricity more effectually and at greater distances than other bodies could do it."—(Hist. Elect., 165.)

The second letter from Franklin, in the sequence illustrating the development of his ideas on the connection of points and thunderbolts, is a memorandum headed " Properties and Effects of the Electrical Matter arising from Experiments and Observations made at Philadelphia, 1749," which was apparently sent to Mr. Collinson with the Letter IV. of July 29th, 1750. In this paper Franklin again explains the power of points to draw off as well as to throw off charge; and then he says ;—" I say, if these things are so, may not the knowledge of this power of points be of use to mankind in preserving houses, churches, ships, &c., from the stroke of lightning, by directing us to fix, on the highest points of those edifices, upright rods of iron, made sharp as a needle and gilt to prevent rusting, and from the foot of those rods a wire down to the outside of the building into the ground, or down round one of the shrouds of a ship, and down her side till it reaches the water? Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief?"

Dr. Priestley quotes another paper by Franklin, written on November 7th, 1749, or probably about the same time as the memorandum last mentioned was written; but this second paper does not appear in the third edition of the Letters from which we have been making extracts. After enumerating all the known points of resemblance between lightning and the electric spark, Franklin says, in this latter paper, "The electric fluid is attracted by points. We do not know whether this property be in lightning, but since they agree in all the particulars in which we can already compare them it is not improbable that they agree likewise in this. Let the experiment be made."—(Hist. Elect., 165.)

In these two extracts, and especially in the first memorandum, headed "Properties and Effects of the Electrical Matter," the invention of the lightning rod is clearly enunciated. They are written some two years after the discovery of the power of points was published; but it is evident that the invention of the rod was, in Franklin's mind, a corollary of the knowledge of this power. We see that all this time not one word is mentioned of any *conducting* power that such instruments might be supposed to have over the lightning or over the electrical discharge. In allusion to the invention of rods, and to the analogy that had previously been observed between lightning and the electric spark, Priestley says:— "It was Dr. Franklin who first proposed a method of verifying this hypothesis, entertaining the bold thought, as the Abbé Nollet expresses it, of bringing lightning from the heavens; of thinking that pointed iron rods, fixed in the air, when the atmosphere was loaded with lightning, might draw from it the matter of the thunderbolt, and discharge it without noise or danger into the immense body of the earth, where it would remain as it were absorbed."—(Hist. Elect., 164.) Here, again, there is no reference to the conduction theory,—*i.e.*, to the idea of conducting the discharge away from the building by means of the metallic stalk of the rod *after* the stroke or explosion has occurred.

Franklin's third letter in the literary chain showing the development of the lightning rod is dated October 19th, 1752, or nearly three years after the vital "Properties and Effects" memorandum. He gives an account in this third letter of an experiment made at Philadelphia (he does not say by whom) with a kite, consisting of a cross made of light strips of cedar with a silk handkerchief extended over it, and having at the top " a very sharp pointed wire " rising a foot above the wood. The kite is held by a silk ribbon (in the hand) attached to the twine-cord, and the person must stand within a doorway, so that the silk does not get wet. " As soon as any of the thunder-clouds come over the kite the pointed wire will draw the electric fire from them," . . . " and when the rain has wet the kite and twine so that it can conduct the electric fire freely, you will find it stream out plentifully from the key on the approach of your knuckle."

It is to be borne in mind that Franklin, in his early letters, uses the term " electric fire " as signifying *electricity*, and not lightning, or the electric spark, as might perhaps have been imagined. In this third letter Franklin is evidently describing the famous experiment he himself made on July 4th, 1752. His language by no means justifies the inference that he conceived that he had drawn *lightning* from the clouds ; and it is clear that his experiment was made solely to test his preconceived theory of the power of points. To all persons having a sound elementary conception of electricity it is abundantly evident that what Franklin effected in this experiment, and what his contemporaries—D'Alibard, De Romas, and Beccaria—effected with simpler apparatus (merely ordinary iron lightning rods with slight gaps in their length), was only to elicit manifestations, during thunderstorms, of the presence of Terrestrial Electricity, primarily in the earth below, secondarily and consequently in the thunder-clouds above. These manifestations were the sparks or flashes that passed across the air-gaps left in the apparatus. There was no explosion of the terrestrial condenser formed by the earth, the clouds, and the intervening atmospheric dielectric,—such as must happen when a *thunderbolt* occurs ; and there was necessarily none of that luminous demonstration of the action of thunderbolts rightly known as lightning.

The fourth important communication from Franklin on these subjects is dated September, 1753, or about a year later. After referring to the question whether the direction of a thunderbolt discharge is usually descending or ascending, and coming to the conclusion that " 't is the earth that strikes into the clouds, and not the clouds that strike into the earth," he states that, in either case, " pointed rods fixed on buildings or masts of ships, and communicating with the earth or sea, must be of the same service in restoring the equilibrium silently between the earth and the clouds, *or in conducting a flash or stroke, if one should be*, so as to save harmless the house or vessel." And, later on in the same letter, he says, "Metallic rods, therefore, of sufficient thickness, and extending from the highest part of an edifice to the ground, being of the best materials and complete conductors, will, I think, secure the building from damage, either by restoring the equilibrium so fast as to prevent a stroke, *or by conducting it in the substance of the rod as far as the rod goes*, so that there shall be no explosion but what is above its point, between that and the clouds."

Here, at last, we arrive (in the portions we have underlined) at the first mention by Franklin of the theory of the conducting action of rods. It is noteworthy that he still, in both passages, gives the preventive power of the rod's point the *first* place; but he now includes conduction of the explosion, after it has occurred, among the functions of the rod. The invention was now, however, public property. Chiefly through the influence of the great French philosopher Buffon, the *savants* of all civilised countries had by this time entertained, discussed, and investigated Franklin's views. He had been in communication with many of them; and we think there is very little doubt that it was principally owing to *their* immature ideas on the nature of electricity in general, and on the laws of its action, that this novel and unscientific theory, whereby the force evolved by a thunderbolt explosion is treated as if it were a current capable of conduction, was harboured by Franklin.

The fifth, and last, extract we shall make from the writings of this eminent man is dated June 29th, 1755, or nearly two years later on. He is writing to D'Alibard in regard to Père Beccaria's views, and he says—"As to the effect of points in drawing the electric matter from the clouds, and thereby securing buildings, &c., *which you say he seems to doubt*, I must own I think he only speaks modestly and judiciously. I have been but partly understood in that matter. I have mentioned it in several of my letters, and, except once, always in the alternative, *viz.*, that pointed rods erected on buildings, and communicating with the moist earth, would either prevent a stroke, or, if not prevented, would conduct it, so that the building should suffer no damage. Yet, whenever my opinion is examined in Europe, nothing is considered but the probability of those rods preventing a stroke or explosion, which is only part of the use I proposed for them; and the other part, their conducting a stroke which they may happen not to prevent, seems to be totally forgotten, though of equal importance and advantage."

The words we have underlined would seem to prove that the leading European philosopher of the day was not at that time convinced of the power of points. In this last letter Franklin definitely entertains the conduction theory; but we think there is strong internal evidence in the letter tending to confirm the notion we have already expressed, that it was mainly in deference to European opinion that he made this addition to his original simple, but well-considered, idea of the efficacy of the rod lying solely in the power of its point in tending to prevent thunderbolt discharges,—in other words, in the action of the rod as a *tap* for the electricity of the ground and clouds. The conception of rods as *conductors* of explosions naturally gathered impetus from the fact of the inventor falling in with it; and this force necessarily received acceleration from the discoveries of the action of currents, obtained from chemical sources, made towards the commencement of the nineteenth century by Volta and his successors. The tendency (which has never yet been impeded) of imputing all electrical phenomena to the operation of *currents* became nearly universal; the term *electric fluid* was taken into general use, and *omne electricum ignotum pro currente* was (as it even now is) a motto of very extended practical application.

From the career of a physicist, Franklin gradually passed to that of a statesman; from the study of *matériel* he proceeded to that of *personnel,* and it is doubtful in which of the two spheres he showed the greater pre-eminence; but the latter was certainly the more cogent and engrossing, involving, as it eventually did, the foundation of a mighty Republic; and his diplomatic employment could have left him scanty time to reflect on, to improve, or to develop his great physical invention. It is interesting, however, to note that the French—the nation to whom the world principally owes the introduction and knowledge of Franklin's rods—have always paid more honour to his original views than have his own countrymen.

To begin with, the French recognise the preventive power of the rod's point by styling the apparatus a *paratonnerre,* whereas we English almost universally (and certainly in all official departments) call the rod a *lightning conductor*, being apparently unconscious that this expression is simply a contradiction in terms, inasmuch as it enunciates the idea of conducting an agency that can exist only in the absence of conducting elements. Indeed, strictly speaking, the idea is one of conducting merely the *manifestation* of an agency, and (so far as the writer can judge from a close analysis of upwards of six hundred detailed incidents of thunderbolt action that have occurred in various parts of the world during the last two hundred years) not even the principal manifestation of that agency; and this makes the appellation still more absurd. In this connection it may be mentioned that the Americans—the successors, so to speak, of the great Philadelphian—invariably use his own term, *lightning rod.*

Again, both the French and the Americans employ on their buildings the original cheap metal that Franklin used and recommended for rods, *viz.*, iron; whereas in England the use of that most expensive metal, copper, is altogether the rule, and the employment of iron the exception. In this respect England is almost, if not entirely, alone among the nations of the world; and probably in no other country is the line of demarcation between electrical experts and tradesmen interested in the manufacture of expensive electrical apparatus so misty and vague. There are few lightning-rod manufacturers who do not consider themselves "electricians" as well, and do not utilise the status they assume as such to promote the sale of their copper wares.

Lastly, the French philosophers still generally adopt Franklin's theory of the dominant importance of points, and, in explaining the functions of rods, they give the preventive power of points the first place, and the supposed conducting action of the rod only the second. If, however, the English mention the preventive power at all, it is always given the second rank, and the conducting idea is awarded the place of honour. The lately departed and justly celebrated philosopher, James Clerk Maxwell, was, however, a unique and conspicuous exception to this prevailing English practice, for he unmistakably manifested his conviction that an ordinary lighting rod was simply a dangerous species of *electric tap.*

It is not within the scope of the present paper to enlarge on the theory of the action of lightning rods, or of the nature of terrestrial electricity,—nor to submit how, if the preventive action of a rod's point be admitted to be the sole advantage and *raison d'être* of the rod, the apparatus may be greatly simplified and cheapened. The writer's object is mainly to draw particular attention to the original ideas of his illustrious countryman, Benjamin Franklin, on the subject of his magnificent discovery; for we must remember (Transatlantic cousins please note) that Franklin was an *Englishman* when he pursued his remarkable physical career and introduced his beneficent invention. Let us Englishmen, then, honour our compatriot more in future in the observance than as hitherto in the breach; and let us all, both Englishmen and Americans, besides noting his original physical ideas, note also his original human motives; for if we do so we shall assuredly find that his wish was not so much to protect the property of well-to-do Church bodies, of wealthy Manufacturers, or of Government establishments, as to defend the lives of the poor and the uneducated cottagers from the ravages made by thunderbolts in rural districts. Is it generally known that (as recorded by official returns) the number of persons killed by thunderbolts in Russia (not including Poland and Finland), in the five years from 1870 to 1874, was 2270, of whom no less than 2161 were dwellers in the country; and that during this period, in the same area, 4192 fires were occasioned by thunderbolts, 4099 of them being in the country?

Let educated men, interested in measures of defence from thunderbolts, obtain (as they easily can by reading) an *elementary* knowledge of the known laws of electricity, especially in regard to the actions of condensers, points, and metals; let them reflect on what they read; and let them *think for themselves* in regard to any steps they may deem it desirable to take for the defence of their own lives and property, or as a rampart for the lives and property of their dependents. Above all, let them follow the original intentions of Benjamin Franklin rather than the guidance of the "electricians" of the present day.

IV. HEATH'S BOLIVIAN EXPLORATIONS.

By Rev. J. D. Parker.

(Concluded from page 451.)

ON September 28th, 1880, Dr. Heath commenced his final voyage down the river. As he pushed his frail barque out upon the water, all the people gathered around and bade him adieu, firmly believing that he and his two Indian companions would be eaten by the cannibals supposed to be living along the Lower Beni. On October 7th, at meridian, he arrived at the lowest point reached on his first descent, and stopped for the night at a point lower down, in 11° 4′ 46″ S. lat. The next morning at 8 o'clock he passed a stream coming in from the south, probably an outlet of a portion of the waters of Rojoaguado, an unexplored lake. To this river was given the name Ivon, in honour of the companion of Prof. Orton, in his last expedition to South America. At 10 o'clock he passed a point of rocks in the river, and came to an island with a large sandbar in front. At this point he landed, and climbed one of the tallest trees to obtain a view of the country, as the dense forest cut off his view on every side. Far to the south, beyond the perennial forest that margins the river, he could see the glimmering waters of an unknown lake. At meridian he came to the junction of the Beni, with a large river flowing in from the north—undoubtedly the Madre de Dios. By triangulation he found the width of the Madre de Dios at the point of junction to be 2350 feet, and of the Beni to be 735 feet, the depth of water in the channel being 50 feet. All animals here were found to be exceedingly tame. He landed on an island, at the junction of the two rivers, within 10 feet of seven Cupibaras, which did not move, evidently never before having seen a man. The alligators found sleeping on the sand-bar did not stir, and the monkeys in the trees on the banks simply lifted up their heads while the boat passed under them, and then went to sleep again.

The only knowledge possessed of this river is the rumoured descent of it in 1860, by Señor Maldonado, a Peruvian colonel of engineers, who, being persecuted in his country for political reasons, is said to have descended the Madre de Dios and Lower Beni, losing his life at one of the lower rapids. Unfortunately all the notes of this expedition were lost.

Alligators had taken out of the boat every night, while moored at the shore, the meat of monkeys killed for provision, which rendered it necessary to shoot monkeys every day. Alligators here were very numerous, and, on account of their great familiarity, Dr. Heath shot two to make them respect them. For greater precaution he placed the meat at night at the head of his bed, as he slept on the shore near the boat, but in the morning the meat was gone, and the prints left by an alligator's feet and tail indicated by what means it was missing. He also found tracks of tigers in the sand near his sleeping-place, and indications where they had dug up turtle's eggs.

The Doctor pushed off his frail boat at 6 o'clock in the morning, and at 6.50 passed the mouth of a large river flowing in from the north, to which he gave the name of Orton, in honour of the celebrated explorer. The land in this vicinity is low and marshy, with few trees. At midday he found a porpoise, which accompanied him all that day and a part of the next, until he came to the upper Rapids just above the Falls. The appearance of this porpoise gave him great encouragement, as the Madeira and Mamoré Rivers are full of porpoises, but the Beni has none. It was an indication that there were no dangerous Falls below him. During the day the Tabanos, a horse-fly, both yellow and black with white-tipped wings, disappeared, and myriads of sand-flies took their place. These sand-flies are found on all the tributaries of the Amazon, and Humboldt estimated that on the Orinoco there are a million of these flies to every cubic foot of air. There are two species of these sand-flies, called Pium and Maruim, differing only in size. During the night, while the Doctor was taking an observation with his sextant, the mosquitoes alighted on his face in such numbers that the blood trickled down on his garments. They got into his eyes, and alighted on his mercury, and disturbed his mercurial horizon to such an extent that he could not take his usual observation. The burning of the Pampas had so filled the atmosphere with smoke that he was compelled to work his artificial horizon without its usual glass cover, and stars of the first magnitude appeared as dim as those ordinarily of the fourth and fifth magnitude. The change from the Tabanos to the Maruims caused him to remember that the same change took place on the Mamoré just above the Falls, and he believed he was approaching the Falls corresponding to the same point in the Mamoré. In the distance he saw tapering columns of smoke escaping from the leafy roof of the forest, which probably curled up from fires burning at Indian camps beneath.

The next day the Doctor saw two turkeys on the bank, so tame that he shot one, and re-loaded and shot the other while it stood looking at its fallen companion. The same day he passed two large islands, and at 10 o'clock in the morning he reached a point where the river was obstructed by rocks, forming a rapid current, which he passed without difficulty, and soon afterward reached the main Falls. Failing to find a suitable passage for his boat on the north side, he passed over to the south side of the river, where he succeeded in drawing the boat over the rocks to the waters below. The difference of level between the water above and below the Falls is 28 feet, the angle of descent of the water in the main shoot is 25 degrees, and the falling water points toward the southern shore, making a dangerous whirlpool, which was passed with great difficulty, his frail bark being almost swamped. The Doctor found a little bank below the Falls, where the two Indians managed to sleep while he sat in the boat all night writing and inking over his pencil notes made during the day, and occasionally bailing out the water from the boat, which had sprung a leak from the concussions received on the rocks the previous day. About 7 o'clock the next morning he passed a number of rocks in the river corresponding with the Rapids Palo-Grande of the Mamoré; for here he recognised the range of hills which he had seen while ascending the other river. Just below this point there is a large island, where Palacios spent the night in 1846, and the last point probably arrived at by Bursa, the Prussian explorer.

Dr. Heath now informed his Indian companions that they were near the termination of their voyage, as he recognised from the hills, and the island 4 miles below the Falls, that they had passed what corresponded to the fourth Falls in the Mamoré River. Ildifongo then asked if there was now hope for their lives? When informed that there was, he said he would call the falls Esperanza, or Hope. From this place they had an unmolested passage to the mouth of the Beni River, where they arrived October 11th, 1880. Here they found the *chacra* which the Doctor had made in August, 1879. There were over two hundred bunches of bananas, ripe and decaying, which furnished them an abundance of food. As the bananas had not been touched, the Doctor inferred the absence of Indians. Loading the boat nearly to the water's edge, they began the ascent of the Mamoré, and passed the first night at the foot of the first Rapids. But his Indian companions, having gorged themselves with food, were taken sick, and were unable to proceed for two days.

In ascending the Mamoré Dr. Heath met with a serious accident at the Falls of Palo Grande, where his boat was overturned and submerged in a fearful whirlpool, his cutting utensils lost, and all his provisions thrown into the river. The situation was critical in the extreme, and the Indians were stupefied with terror. Dr. Heath first secured his boat; then, seeing his *farinha* sewed up in an ox-hide, and two of his paddles floating around in the centre of the dangerous whirlpool, he plunged into the river. The Indians beheld this hazardous act with amazement, and uttered a cry of terror. Should the Doctor be drowned, how could they escape from the wilderness? and, if they should escape, they would probably be shot under the suspicion of murdering him. Swimming to the *farinha* the Doctor placed his hand upon it, and, being carried round and round in the surging whirlpool, he gradually pushed it out; after which he secured two of his paddles in a similar manner, escaping from the whirling water after these almost superhuman efforts in a perfectly exhaustive condition. When the boat passed the Falls it was reloaded with the instruments which had been taken out and carried around. But the Doctor's paddle of green wood had sunk in the whirlpool, and he had lost all his tools for making another. Fortunately he found a piece of wood that had been roughly blocked out for a paddle, and by charring the wood and rubbing off the charred portion with a sharp stone he made himself another paddle. In this he displayed the same fertility of invention to supply his necessities which characterised the whole expedition. Their frail barque now leaked very badly, and the waves ran so high on the river during stormy weather that sometimes they were compelled to tie up to the shore. One night, while camping on the shore, the Doctor noticed that the boat began to fill with water, and he had barely time to arouse the Indians from sleep and unload the boat before it sank. On the following day, after much hard work, the boat was made to float, when it was reloaded, and they pursued their way.

On the 20th of October, while on the Brazilian side of the Mamoré, Dr. Heath heard some one calling, and saw with a field-glass a naked Chacobo Indian, who was standing on the sandy shore of the opposite side, and was trying to induce them to come across the river. When no attention was paid to him, twenty armed savages sprang out from the shelter of the trees, where they were lying in ambush ready to attack the boat should it approach that shore.

Without any further accident Dr. Heath arrived at Reyes December 11th, where he was received with every demonstration of joy. The school children, hearing of his safe return, went out from the town about 3 miles to greet him with songs and floral offerings. When he arrived at Reyes the church bells were rung, and there was a public ovation.

Soon afterward Dr. Heath ascended the Beni River on a balsa raft, and thus completed the map of the river from its mouth to its source near La Paz, when he took his departure from South America, and October 16th, 1881, he arrived in New York.

Most fruitful in results has been the exploration of the Beni River. It has materially corrected the geography of that portion of South America. Two hundred leagues square of rubber trees have been opened to commerce, where each square league will contain from three hundred to five thousand trees. This will furnish work to large numbers of men ten months in the year, each man being able to collect from 10 to 25 pounds of rubber daily. It shortens the route of transportation of the products of the Lower Beni from 700 miles to less than 300, and necessitates the passage of only one fall in the river instead of five falls. For the larger portion of Bolivian commerce it obviates the toilsome transit over the Andes, and the long voyage around Cape Horn or through the Straits of Magellan.

V. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 412.)

IT was stated in a previous article that the teacher in the Department's Science Schools, on account of being paid on the result system, must teach his pupils to pass. Whether they know the subject they are taught must necessarily be to the teacher, as far as his own self-interest is concerned, of very little, even of no, importance compared to that of their passing: he will therefore devote special attention to those who are most likely to pass,—to those who have, he finds, the best verbal memories. We will now give extracts from the reports of the Department's own examiners as proof of the correctness of this statement. But before giving the extracts, I will give a question and answer taken from the Report of the Select Committee on Schools of Art, published in 1864, on this subject. Mr. Edmund Potter, a member of the Committee, tendered himself for examination. Amongst other questions asked him, several related to what he would consider the best mode of paying teachers in the Department's schools in order to secure the best instruction. He recommended that the teachers should be paid by salary. He thus expressed himself as to the payment on result system. The question asked—"Do you prefer that system (payment by salary) to the system of payment upon results?" Answer—"I think the system of payment upon results is a complete absurdity myself. I think it will have a bad effect upon the schools: a master will take the quick scholars and work them up, and the dull ones may take their chance."

In giving the following extracts from the Reports of the Department's own Examiners, I may state they are taken from the most favourable of their educational institutions, viz., the Training Colleges; and although, as far as I can make out from the 29th Report, only four annual examinations had been held up to December, 1881, in these Colleges, I think it will be admitted by all who read these extracts, that the science teaching in these institutions is of a very doubtful character.

It must not be forgotten or lost sight of in considering this part of the subject the length of time the Department has had the direction and complete control of the Governmental science teaching in the country, and the large amount of money Parliament has voted yearly for that purpose. If science teaching according to the *Department's system* had only been four years in operation, it would not be acting fairly to those having the direction and supervision of that system to expect even in the Training Colleges strictly efficient teaching in all the different branches of Science. But when we call to mind the fact that the Department of Science and Art has been in existence nearly thirty years the case is very materially altered. The Department was created in March, 1853; in 1855 the different Science and Art institutions of the country had been grouped under it, and the Parliamentary grant that year was £80,000. The grant increases every year. In the present financial year, 1883-84, it amounts to £365,690; the administration alone amounts to £32,110; and although the £365,690 is not all expended on schools and colleges, large sums have been expended upon them, so that if a sound educational system had been introduced, one more in accordance than the present one is with the systems adopted by other civilised countries, the nation would have benefitted, as Germany and other nations have benefitted, by the cultivation of the inductive sciences.

The following are the extracts I have alluded to: they are taken from the 29th Report of the Department:—

Prof. Judd and Mr. Lockyer, the Examiners in Physiography, say:—"The number of candidates in the subject of Physiography increased this year (1881) from 618 to 767. *Unfortunately* there is reason to fear that this increase was caused by students being sent in for examination from colleges *where very inadequate instruction* is given in science. In many cases the answers show how imperfect the instruction has been. Thus *throughout whole colleges* we find the prevalent idea to be that *mercury in a centigrade thermometer cannot rise above* 100 *C., or sink below zero.* In other colleges *all* the students state that in order to *separate* a substance dissolved in water *from its solvent* it is necessary to *decompose the latter* by means of a voltameter.

Dr. Russell, the Examiner in Inorganic Chemistry, says: "I do not think that either the *theoretical* or *practical* examination was quite satisfactory. The *nature* of the answers and the *way* they are stated gave me the impression that *these subjects are learnt only with the object of passing the examination.*"

Mr. Thiselton Dyer, the Examiner in Botany, says:—"A detailed examination of the *successes* and *failures* still, however, leaves *much room for dissatisfaction.* With regard to *the method of teaching*, it is quite clear that the practice is still too largely resorted to of using *mere 'book-drill' instead of intelligent oral teaching.*"

Prof. Huxley and Dr. Michael Foster, the Examiners in Animal Physiology, say:—"There has *apparently* been a fair amount of diligence bestowed on the matter; this has been rewarded by a *large* number being *allowed* to pass. *But that diligence has been largely misdirected;* the *characters* of the answers *clearly show* that the candidates *prepare* themselves for this examination, *not by attempting to understand* physiology, *but by loading* their memories *with statements* which may be *re-produced* in the examination room."

Prof. Guthrie, the Examiner in Sound, Light and Heat, and Electricity and Magnetism, says:—"Generally, and in respect of both subjects,—sound, light, and heat, and magnetism and electricity—the answers have shown an improved, but *only slightly* improved, knowledge of physics; but in many cases *the teaching appears to have been mainly theoretical.* Many of the answers show that the examinee, while *understanding the conventional description* of a piece of apparatus, has *probably never seen it, and certainly never used it.* THIS WON'T DO."

The above extracts are instructive examples as to the *present state* of science teaching under the Department's system. It is difficult to credit, although stated by the Department's own Examiners, that the instructed in *many colleges* are so ignorant, not simply of science, but of common information, that they believe that mercury in a centigrade thermometer cannot rise above 100° or sink below zero; or that the only way to separate a substance dissolved in water from its solvent is by decomposing the solven by a voltameter. Such dreadful ignorance is almost incredible; and the sooner a system, under which such ignorance fructifies, is swept away the better for the country; for, to use Prof. Guthrie's expression, "it won't do."

Practical as well as theoretical examinations in chemistry have been held during the last few years. 1878 appears to be the first year in which they were held. As I am about to cast a doubt upon the possibility of conducting the Honours Practical Examination in Organic Analysis, as given in the examination papers for Science Schools and Classes in 1882, in any Elementary Science School, it will be necessary to make some explanatory statements in order to carry my readers along with me. Neither the examiners nor the teachers are present at these examinations; they are in charge of persons who may have no knowledge of chemistry. How practical examinations can be conducted properly under such conditions I am at a loss to understand. In the Practical Examination in Inorganic Chemistry in the advanced stage, a substance is given the candidates, according to their examination papers, for "analysis qualitatively," which may contain any or all of thirty-four elements and compounds. But strange to say, in the higher, the Honours, paper the qualitative analysis is limited to a substance which will contain *only four* out of the thirty-four elements and compounds. Those who go in for Honours have in addition to make an estimation of the amount of lime, or some similar base, in a solution.

If the Examiners inspected these Science Schools, this practical instruction would certainly be a forward step in the right direction; but as long as inspection is not combined with the examinations, how the analytical courses are taught, whether by mechanical or scientific methods, cannot be determined by the Examiner; and how we teach, it must not be forgotten, is far more important than what we teach. I have already stated (p. 162) that a person totally ignorant of chemistry may be trained to perform mechanically different chemical operations, as a man can be taught mechanically to work a steam-engine. The porter in a chemical laboratory is frequently trained to prepare most difficult chemical preparations; and boys without the least acquaintance with the science are frequently taught in chemical factories to analyse quantitatively the substances manufactured in the particular factories to which they are attached. I have met with—and I have no doubt other chemists have also—workmen in smelting works capable of assaying copper ores by the *dry method* with an accuracy which an experienced chemist could not equal until after some considerable practice. The mere performing the analysis, whether qualitative or quantitative, of inorganic substances, is no proof that the student who has performed them has been taught the science as a science. Dr. Russell, the Examiner, does not, as will be seen from the extract I have given from his report, believe that they are taught the science in the Training Colleges, but that "these subjects are learnt only with the object of passing the examination": in other words, it is mere cram.

The practical examinations in organic chemistry are far more difficult, and if the substance sent in the Advanced Stage for analysis is on a par as regards difficulty with what is too succinctly stated in the pamphlet entitled "Science Papers," I have no hesitation in stating that the student who analyses the mixture *correctly* is not likely to have been taught in a purely mechanical manner, for analytical tables will not enable him to analyse organic substances, as they do inorganic ones, altogether in that fashion; he must have a pretty good knowledge of the properties of the organic bodies he has to look for. I give what is contained in the printed document—

"ADVANCED STAGE."

"The examination in the Advanced Stage is confined to the qualitative analysis of a mixture which may contain any or all of the following constituents, together with one or two inorganic bases:—Hydrocyanic acid, formic acid, oxalic acid, acetic acid, benzoic acid, succinic acid, tartaric acid, and citric acid."

The time allowed for the analysis of a mixture of that sort, according to the document from which I extract it, is three hours; but in a later Time Table, which has been sent me indirectly from the Department, four hours is the time stated. Anyone who would analyse *correctly* in four hours a mixture containing 75 per cent of the organic acids named, and had to search for the whole of them, and that the two bases were of varied character, would deserve to be classed as an expert analyst: those unacquainted with chemical analyses would not comprehend the complexity of the analysis unless they were informed that it is frequently more difficult to prove the absence correctly of a substance, especially in organic mixtures, than to prove correctly the presence of one, if the mixture is at all a complicated one.

Before quoting the Honours paper we must recall to the recollection of our readers the class of students on whom alone the teacher can receive payment on results, the *time* when he must teach them in order to be able to receive the payment if they pass the examination successfully, and other particulars; but the question about the numbers who come up for examination and the cost must be deferred until the next article.

The teacher receives payment on results of instruction as tested by the examination of the students; only for those who belong to the artizan class, or persons, and their children, who are in receipt of not more than £200 a year, and teachers and pupil teachers in some elementary schools. The time for the class to meet according to the Department's instructions, in order to receive the payment on results, is after 6 p.m., every week-day except Saturday; on the latter day it can meet at 2 p.m. Twenty-eight lessons must at least be given in each subject; when the subject is taught theoretically it must last at least one hour; but when it is taught practically it must last at least one hour and a half; and two lessons on the same subject cannot be given on the same evening or afternoon. All the subjects are divided into three stages, and a separate set of examinations is set in each. In each stage—Elementary, Advanced, and Honours—there are two grades of success, 1st and 2nd class. "The Elementary and Advanced Stages," states the Science Directory, "are for the ordinary Science Schools. The Honours Examination is of a very advanced character." It will be observed that in the Directory the Department is very mysterious about the Honours Examinations; they are equally mysterious, as we shall find further on, as to the number who go in for them in each subject; they do not say, it will be observed, whether the examinations in Honours *are held or not* in the night classes. If they are not held in these classes, why put down the payment on results which the teacher will receive for this stage, because on no other class but the artizan, and £200 a year, class, can the teacher receive result payments, and these classes must, we have seen, be taught at night to receive even on them.

The payments are as follows:—

1. In the Elementary and the Advanced stages of each subject, except Practical Chemistry, £2 and £1 for a first or second class respectively.

2. In Honours, £4 and £2 for a first or second class respectively.
3. In Practical Inorganic and in Practical Organic Chemistry, £1 10s. and £1 for a first or second class respectively in the Elementary stage; and in Practical Inorganic and in Practical Organic Chemistry, £4 and £3 for the first or second class respectively in the Advanced stage and in Honours.

It is noteworthy that the payments are the same in amount in the Elementary and Advanced stages for the different subjects, including chemistry, when taught *theoretically*, but it is reversed when chemistry is taught *practically*, the payments made in the Advanced stage being equal to those made in the Honours stage.

I am fearless in avowing my disbelief that the examination in Organic Analysis in the Honours stage takes place in any of the Elementary Science Schools; for even in such a pronounced scientific institution as the Victoria University *only a few* students could be examined at the *same time* in that subject. I will first give the examination paper as given in the "Science papers," and then I will state my reasons for the opinion just expressed.

"HONOURS."

"The examination in honours consists of a qualitative analysis of a mixture supplied, and of the determination of the percentage of carbon and hydrogen contained in the organic substance distributed for this purpose.

"The bottle marked (A) contains a substance in which the percentage of carbon, hydrogen, and oxygen (the latter by loss) is to be determined by ORGANIC ANALYSIS."

For the information of those who are not acquainted with chemical analysis, it is desirable to state that, for the mere execution of the analysis, no great amount of chemical knowledge is required; but great manipulative skill is requisite for its successful execution; also costly apparatus is required; and a *space*, varying in extent with the number of persons who can be making the analysis at the same time, but considerable in extent, even for one person, must be specially fitted up in the laboratory for that analytical operation alone. It is also a very lengthy operation as regards the time required, even for one analysis, and, unlike most other analytical operations, it must be completed on the day it is commenced.

The time allotted for its execution at the examination is, according to the Department's time table, from 2 p.m. to 10 p.m., which is not too long; but if it requires that length of time in the examination room to perform it successfully, it must require for its proper execution an equal length of time in the class room, so that those who commenced to make an organic analysis at 6 p.m. in the night class would have to continue at their labours until about 2 a.m. the following morning. Further, each of the candidates at the examination, as they must be started equally, must be provided with a *balance* and a box of chemical weights, and the balance, as accuracy must be the test as to the proper execution of the analysis, must be so delicate that it will *turn* with the one-thousandth part of a grain. Other costly apparatus would also be required by each student, and, as has been stated, a large space must be specially fitted up in the laboratory for the purpose.

What science teacher who is paid on the result system would undertake to instruct students, even if he were capable and had the necessary apparatus, &c., in this difficult branch of chemical analysis; for if they gained a second class only, he would only receive a third more in money than for a first in the theoretical elementary stage, and he could *cram up* 20, 30, or 40 students for examination in the latter stage in the time it would take him to teach one or two students to make organic analysis, and in the elementary stage he could count on a larger percentage of successful students.

But how are the laboratories for these night classes fitted up, even for the study of practical inorganic chemistry in the most elementary stage; I will give the description of one, as it has been given to me, in one of the leading manufacturing towns in England. It was sent me by a gentleman who is personally unknown to me. He wrote to ask me for advice on educational matters. I advised him to study chemistry in a laboratory: the only time he could devote to study was the evening. He therefore went to the Practical Class under the Department, but he gave up attending it after a short time owing to the disorder preventing any work being done. This is his description:—"The laboratory class I attended for a short time was under the Science and Art Department; it was at the Central Board School. The laboratory was originally intended for the day scholars. There seemed to be no kind of order kept with the day pupils, for when I went in the evening I had to *hunt* for most of the test bottles, and even our private cupboards were *rifled* of necessary apparatus. You will readily conceive *how much work* it was possible to get through during the hour and a half, when *most of the necessaries were to be sought for and cleaned or filled ere anything could be done.* It was not in the teachers' power to mend matters, as he had nothing to do with the day class." That laboratory certainly was not a favourable place for studying even the rudiments of inorganic chemistry, and therefore certainly not for learning organic analysis.

With respect to the number of places fitted up for organic analysis in laboratories which are almost exclusively devoted to research in organic chemistry, I may state that a friend of mine informed me only the other day that when he was studying in the leading laboratory in Paris, there were *only two* places. Let me add, further, that evening classes are carried on in the Victoria University, Manchester; in looking over their Examination Papers for the Session 1877-78 (I have not a later Prospectus to refer to), I find *no such* examinations as those the Department state they carry out in their schools. From the experience I have had in conducting and superintending practical examinations in analytical chemistry, I consider that it would not only be desirable, but that it is absolutely necessary, for conducting them properly that these examinations should be in charge of a chemist who has had experience in teaching that branch of the Science. Even for the Honours stage in inorganic chemistry, scientific supervision is required to direct the examinees in the arranging of their work, so that they do not clash by each wanting, for instance, the same piece of apparatus at the same time.

Even if the practical organic examinations could be carried out, there nevertheless arrives a time when it is most desirable that examinations should not be prolonged, whatever may be the subject examined upon, and whatever may be the object of the examination. Mr. Todhunter, in his work "The Conflict of Studies," and other acknowledged authorities, strongly insist upon this point. But under the payment on result system, even for the teacher to earn the sum of £1, the costly and inefficient examination machinery of the Department has to be set in operation; the plant of knowledge is thus being constantly plucked up to see how it is growing; the authors of the system forgetting or disregarding that "study requires some amount of peace and quietness, without the constant expectation of being called to 'stand and deliver.'" Would that our senators at least would ponder over the following pregnant remarks by Mr. Herbert

Spencer :—“ And pervading the whole, is the vicious system of rote learning—a system of sacrificing the spirit to the letter. See the results. What with perceptions unnaturally dulled by early thwarting, and a coerced attention to books, —what with the mental confusion produced by teaching subjects before they can be understood, ... —what with making the pupil a *mere passive recipient of other's ideas, and not in the least leading him to be an active inquirer or self-instructor,* —and what with taxing the faculties to excess—there are very few minds that become as efficient as they might be. Examinations once passed, books are laid aside ; *the greater part of what has been acquired, being unorganised, soon drops out of recollection ; what remains is mostly inert, the art of applying knowledge not having been cultivated, and there is but little power either of accurate observation or independent thinking.* To all which, add that, while much of the information gained is of relatively small value, an immense mass of information of transcendent value is entirely passed over.”

If, in order to relieve our Senators of embarrassments in connection with Civil Service appointments, competitive examinations have been resorted to as the only possible means of selecting candidates for these appointments, why employ them at least to the extent that is at present being done, to test the extent and progress of knowledge in educational institutions, when it is admitted by all competent authorities that the general education of the kingdom is being seriously injured by these competitions ?

Written examinations are no test of sound attainments in any branch of knowledge ; but they are the least fitted to distinguish thorough from superficial knowledge in the inductive sciences. The only thing these examinations do test is the relative capacity of the candidates for acquiring and retaining for a time the ideas of others, and of reproducing them on paper. This is a very desirable quality for those intended for the legal profession to possess ; but it is a quality almost the reverse of desirable for those who study the inductive sciences either for their purely scientific extension or for their technical applications. This examination system is entirely opposed to the educational system carried out in Germany : the German students are taught the art of applying knowledge and of extending it ; our students are merely taught to be passive recipients of others' ideas, and to be capable of reproducing them on paper. See the results. German chemists are year by year being more employed in our chemical factories, so that, since the time the Science and Art Department was created, our calico-printers have had to rely more than they did before its creation upon the Paris *ateliers* for designs; and our chemical manufacturers seek far more than formerly scientific aid from Germany.

Is this a pleasant picture for Englishmen to contemplate after all the heavy taxation they have had to endure for thirty years for the promotion, as they have been led to believe, of scientific and technical instruction? What reply can that most expensive and overgrown bureaucratic Department make to this statement of facts?

NOTE.—Even if organic analysis could be carried out in the Elementary Science Schools in conformity with the Honours' paper, it would nevertheless be a most inappropriate competitive test as to the relative degrees of skill and knowledge of different students in these, or in any, schools or colleges. Because the *glass tubes* in which the analysis has to be made will not unfrequently break on the application of the required heat; and if the tube breaks the analysis is destroyed, and has to be commenced afresh; and the breakage most frequently occurs from no want of skill on the part of the analyst. If, then, for example, out of six students competing in this stage, the *tubes* of three of the students were to break, how could marks be fairly given at all in such a case.

(To be continued.)

ANALYSES OF BOOKS.

*Wieder die Humanasters! Rechtfertigung eines Vivisectors.** By Friedrich Goltz, Professor in the University of Strassburg. Strassburg: Karl J. Trübner.

For this incisive and decisive little work we must bespeak the careful attention of our readers, and of all persons who are desirous of forming an honest opinion on the so-called "Anti-Vivisection" question. A word may be needed concerning the title. As the poetaster is a caricature of the true poet, and the philosophaster of the genuine philosopher, so the humanaster is a burlesque on the man of rational humanity. This word, proposed by the Rev. Henri Tollin, of Magdeburg, is no less happy than Prof. Owen's term "Bestiarian."

Turning from the title to the subject, we must introduce the reader to a man and a book. The book is the "Torture-Chambers of Science,"† the official manual of German bestiarians. The man is its author, a certain Ernst von Weber, a "knight of high orders," as he seldom forgets to inform the public. To get an idea of this man we must imagine our leading British bestiarians all blended together into a "thick and slab" compound.

Now Prof. Goltz has admittedly performed a number of experiments upon dogs, chiefly with a view to elucidate the organisation of the brain and its relations to the entire nervous system. He has described these experiments and their results in a special work. In the Introduction to this work he has expressly stated that all the subjects upon which he operated were, before the commencement of the experiment, brought profoundly under the influence of chloroform, and were hence absolutely unconscious of pain.

The "Knight of high orders," however, in compiling his "Torture-Chambers," has quoted numerous passages from the work of Prof. Goltz, as proofs of the cruelty of physiologists, and these quotations have naturally produced a sensation of horror among the lay public. But our "Knight" has carefully concealed the fact that the animals had been subjected to an anæsthetic, leading, or at least allowing, his readers to suppose that they were in their normally sensitive state. Herr *Von* Weber has therefore here been guilty of the *suppressio veri* in a manner which would have been discreditable even to a pettifogger or a professional agitator. But he has gone still further; in two passages of his "Torture-Chambers" (edit. 5th, pp. 11 and 26) he has formally asserted that Prof. Goltz did not make use of anæsthetics! Now as he has carefully studied the writings of Prof. Goltz, in order to extract from them whatever passages, duly garbled, would serve his purpose, he has in these passages wilfully and consciously stated the "thing that is not." It is not our custom to use, in the pages of the "Journal of Science," those plain old Saxon words which can alone fitly characterise this "Knight" and his style of controversy and agitation; but we leave our readers to draw their own conclusions as to the weapons which the Bestiarian advocates think worthy of themselves and their cause, and as to the materials upon which Anti-vivisectionist sentiment is founded.

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* Against the Humanasters! Justification of a Vivisectionist.

† Die Folter-Kammern der Wissenschaft.

Herr Von Weber's assertions have been repeated over and over again by his imitators and followers, and the public—good, easy souls!—have never looked into the writings of Professor Goltz to see if Herr Von Weber's quotations convey the truth, the whole truth, and nothing but the truth.

Surely this one case on the part of one who is, out of England, probably the most prominent "Humanaster" in the world, ought to inspire all candid inquirers with a wholesome caution. Well and truly says Prof. Goltz, "The humanaster is an inversion of the rag-collector. The latter seeks out from amidst rubbish whatever is capable of utilisation. The humanaster grubs in dirt for the sake of the dirt. Whatever seems fit to excite horror and disgust is eagerly dragged forth; whatever is useful to mankind is carefully hidden, so that the multitude may know nothing about it."

Prof. Goltz then proceeds to convict the Bestiarians of want of truthfulness in other directions. They claimed Darwin as one of their adherents, till his letter to Prof. Holmgren and his formal accession to the Society for the Promotion of Medicine by Research refuted the calumny. In like manner the enemy have claimed Cuvier, Sir Charles Bell, and Hyrtl as authorities in their favour! Prof. Goltz refers his readers, on the contrary, to Cuvier's *éloge* of the vivisector Flourens. The assertion that Bell rejected experimentation on living animals he proves to be a pure invention, and cites numerous passages from the German version of the works of the great anatomist. Hyrtl, he shows, was diligent in vivisection,—often unnecessarily so.

Having thus disposed of the real men of Science whom the Bestiarians falsely claim, the author declines to notice the "scientific walking gentlemen" who swell the ranks of the enemy. If, as the Humanasters allege, all the problems of physiology can be solved without the aid of vivisection, he challenges them to prove their words.

With an able sketch of the inconsistencies of the Bestiarians, and of the shifts and shuffles with which they seek to justify or to palliate such inconsistency, he concludes his little but weighty work.

We would venture to recommend this pamphlet to the careful notice of all biologists and physicians. Would not the Society for the Promotion of Medicine by Research find a translation of Prof. Goltz's plain, straightforward publication an excellent work for distribution?

Micro-Photography, including a Description of the Wet Collodion and Gelatino-Bromide Processes, together with the Best Methods of Mounting and Preparing Microscopic Objects for Micro-Photography. By A. Cowley Malley, B.A., M.B., B.Ch., T.C.D. London: H. K. Lewis.

Without Micro-Photography microscopic research is deprived of one of its most important auxiliaries. The observer may, indeed, preserve his mounted objects to refresh his memory, or for exhibition to his friends and colleagues; but if he wishes to lay his results before the scientific world at large, he, but for micro-photography, has no other resource save drawings executed by hand. Concerning these Dr. Malley very justly remarks:—"I have before me at present some drawings which must have taken the artist a week to finish, and even then show the existence in his mind of preconceived notions of structure."

The second chapter of the little work before us is devoted to the properties of lenses, the imperfection of resulting images, aberration, &c. Though much of the information here given will doubtless be familiar to all persons likely to be working with the microscope, the views of Prof. Abbe, of Jena, here quoted, may be of advantage to many.

In the third chapter we have an account of the microscope, and of the means of illumination, for which purpose the author recommends Swan's electric lamp. The camera and its accessories, the arrangement of the dark room, and the mounting and preparation of objects for micro-photographic purposes are next described. The photographic processes are next considered.

The receipts for the solutions required in the collodion process are given in metric weights and measures, though in the developing solution we meet with the unusual abridgment in alcohol, 2 $\underline{^{s}}$. The formula for the hyposulphite bath is given, however, in ounces, the pharmaceutical symbol being somewhat strangely employed. On pp. 83 to 88 the formulæ employed are all expressed in pharmaceutical symbols. This is surely an error, since all those of Dr. Malley's readers who are neither medical practitioners nor pharmaceutists will fail to understand these somewhat cabalistic characters, and before setting to work will have to get them interpreted. In our opinion all the formulæ should have been given either on the metric system or else in "parts." Passing over this survival of the unfittest, the work seems likely to be of great service to microscopists.

Elementary Text-Book of Physics. By J. D. EVERETT, M.A., D.C.L., F.R.S.E., Professor of Natural Philosophy in the Queen's College, Belfast. London: Blackie and Son.

AFTER a careful examination we must pronounce this work—as might, indeed, be naturally expected from the standing of its author—unexceptionable, both in the matter and the manner of its teachings. It may seem, therefore, paradoxical if we declare ourselves unable to accept certain views here laid down. Dr. Everett, in his Preface, writes:—"It [*i.e.*, the book before us] aims at presenting, in brief space, those portions of Theoretical Physics which are most essential as a foundation for subsequent advances, while at the same time most fitted for exercising the learner in logical and consecutive thought. It does not give minute directions for manipulation; but, avoiding details as much as possible, presents a connected outline of the main points of theory.

"In order to place Science upon an equal footing with the more established studies of ancient languages and mathematics, as a means of practically training the bulk of our youth to vigorous thought, it seems necessary that Science text-books should be constructed upon such lines as these. It is not practicable to make the bulk of the boys in our public schools expert scientific manipulators, but it is practicable to ground them well in the main lines of scientific theory. The aim must be not so much to teach them many facts as to teach them rightly to connect a few great facts together. Science must be taught them from a liberal, not from a technical, standpoint."

We regret that we cannot accept the author's contention. We submit that the object of the introduction of Science into an educational course is to teach youth not mere "vigorous thought," but a something which classics and mathematics cannot even attempt to do, and which they rather unteach when cultivated alone, *viz.*, the arts of observation, and of drawing right conclusions from the phenomena witnessed. But this cannot be done by reading or by hearing lectures, or even by witnessing experiments. An eminent American authority has said that the only sensible way to teach Botany is to begin with plants, and merely refer to books by way of summarising the facts thus learned. Science should be taught the pupil not from a *wordy*, but from a *thingy* standpoint. The exact degree of manipulative skill acquired is not so much the question as the acquisition of those habits of observation which our present and past systems of education have aimed at destroying.

The work before us would furnish an admirable text-book for pupils who can in every case start from the facts.

Household Chemistry: for the Non-Chemical. By Alfred J. Shilton, F.C.S., Lecturer on Organic Chemistry at the Midland Institute, Birmingham; and at the Walsall Institute. London: F. V. White and Co.

We have here a work which, though in smaller compass, reminds us in some respects of Johnstone's "Chemistry of Common Life." It differs, however, in the more copious introduction of chemical formulæ.

The author remarks that certain earlier works, covering to some extent the same ground, have been at fault in containing matter "not of a strictly chemical nature, and which, however interesting in itself, swells the book to a large size without adding to its usefulness." On this we may remark that in a popular treatise it is sometimes difficult to observe the boundary-lines of strict method. Of this Mr. Shilton himself is an instance, since in his chapter on Candles (Chapter IV.) a great part of the information given relates to purely mechanical operations. No small portion of the concluding chapter, also, might be referred to a treatise on "Household Physiology."

The instruction given in the work must be pronounced, as far as we perceive, accurate in itself and clear in exposition. We are much pleased with the author's remarks upon ozone, the faith in which may deservedly rank as one of the superstitions of this scientific age. We are far from certain whether, when, and to what extent, this body exists in the atmosphere. Granting its presence, its sanitary value is a still more doubtful question. From experiments made with ozone, as artificially prepared, it seems to have no very beneficial action upon animal life.

The chapter on Water also contains much of which we must express our approval. The author gives it as his opinion that soft waters are dietetically preferable to such as are hard. With this we agree. That some towns supplied with soft waters have a higher death-rate than that of certain others consuming hard waters proves nothing, unless all the other conditions were alike. We scarcely agree, however, with the author's expressed preference for the waters of deep wells as against that collected from uncultivated siliceous uplands. We fear that in populous districts organic pollution must gradually extend deeper and deeper into the earth's crust.

The author's condemnation of the use of plaster of Paris in the sophistication of wine is very much needed. Were the Customs instructed to confiscate and destroy all wines containing more sulphuric acid than the maximum found in the juice of the grape, this mal-practice would soon come to an end.

Mr. Shilton's work may be safely recommended.

Economy of Coal in House Fires, or how to convert an Ordinary Fire-Grate into a Slow-Combustion Stove at a Small Cost. By T. Pridgin Teale, M.A., F.R.C.S. London: J. and A. Churchill. Leeds: C. Goodall.

The author's principle is to cut off the current of air which ordinarily passes through the fire-grate and its contents from below, and to keep the space beneath the grate hot. It is admitted that the mere interception of the bottom draught without the warm chamber beneath the fire-box will be unsuccessful. With his first rule we agree most heartily:—"As much fire-brick and as little iron as possible." It is to be regretted that for the last half-century we have been retrograding in the con-construction of fire-grates. The object of inventors in this direction—mostly founders or ironmongers—has been to sell a maximum weight of cast-metal. With the exception of Mr. Teale's "economiser," a sheet-iron shield for shutting in the chamber under the fire, he returns in most points to the structure of the grates used a century ago. He recommends a horizontal fire, deep from front to back, and with its back and sides of fire-brick.

We have no doubt that the arrangement here described is a step in the right direction. Nevertheless we think that comfort, economy, and the necessity of minimising the products of combustion in our towns, all bid us to go still further, and renounce our open fires in favour of stoves constructed of tiles and fired up in the passage.

Report of an Exploration of Parts of Wyoming, Idaho, and Montana, in August and September, 1882; made by Lieut.-Gen. P. H. SHERIDAN. With the Itinerary of Col. J. F. GREGORY; and a Geological and Botanical Report, by Surgeon W. H. FORWOOD. Washington: Government Printing Office.

THE first fact we notice in the topographical account of the region traversed is that the trout of Spring Creek and Wind River have dark spots on their sides, whilst the trout in the streams east of the Mississippi have red spots. It is pleasing to learn that Gen. Sheridan prohibited the killing of more antelopes than the Expedition could consume.

It is remarked that the water of the Shostone Lake is "as blue as indigo." Whether this colour, as in some small lakes in Transylvania, is due to a salt of copper, is not mentioned.

Gen. Sheridan notices that the National Park is in some danger from encroachments, and that the game is being rapidly killed off. He proposes to keep out the skin-hunters by means of his troops. Col. Gregory also notices acts of "vandalism," from which the magnificent geysers of the park have suffered no little.

The speed at which the Expedition moved was inimical to geological and botanical research. Nevertheless Dr. Forwood made a considerable number of interesting observations. He finds, by comparison with the reports of former visitors, that the great geysers are not decreasing perceptibly in strength.

It is curious to notice the paucity of ferns encountered, the only species recorded being *Woodsia Oregana*.

Second Report of the Department of Entomology of the Cornell University Experiment Station. By J. H. COMSTOCK. Ithaca: Andrus and Church.

THIS Report deals exclusively with what may be called the economical phase of Entomology,—the identification of the insects harmful to field- and garden-crops, the descriptions of their habits, and suggestions for their extirpation, or at least diminution. This study has been forced upon the agricultural interest in the United States in consequence of the exuberance of insect-life under their more brilliant suns; partly also, perhaps, from the large size of the fields, and the substitution of rail- and wire-fences for live hedges, thus depriving the insectivorous birds of shelter. Hence in America the entomologist is no longer sneered at as he once was, and as he still is in some parts of "this our highly favoured country."

It comprises a valuable monograph of the scale-insects,—pests which are now being transmitted from one country to another, and which, even where the climate is uncongenial, make themselves at home in conservatories.

From this Report we may learn how easy it is for insects to change their diet, and thus suddenly rank as enemies to the husbandman.

Another reflection, not to be overlooked by Zoophilists, Neo-Buddhists, and the like, is the impossibility of existing without taking life. If we eschew all animal food we must still destroy animals by myriads, or no vegetable nutriment will be left for us to consume.

Memoirs of the Geological Survey of India. Vol. XIX., Part 1. Calcutta: Geological Survey Office. London: Trübner and Co.

THIS part is an account of the Cochar earthquake of January 10th, 1869, by the late Dr. T. Oldham, F.R.S. At the time of the occurrence he was at Barrackpore, about 15 miles from Calcutta, but, according to the instructions of the Lieutenant-Governor, he went to Cachar and Silchar to observe the results of the shock at its centre. It appears that six or eight shocks had occurred in 1866, chiefly between January and April, whilst none are recorded in 1867 and 1868. It is remarked that in the Silchar cemetery the upper slab of a tomb, a heavy mass of marble, had been projected from the body of the tomb more than 8 feet in a north-north-easterly direction.

At Sylhet, according to the Executive Engineer, a peculiar tremulous, "almost stinging," sensation was experienced in the feet. At Manipur it was noted that, though the shock lasted about a minute and a half, the lower animals did not seem at all affected.

Passing over numerous details of the effects of the shocks in different places, we come to generalities.

It is concluded that the shock originated in a fissure about 20 miles long, on the northern margins of the Jaintra Hills. The mean depth of the focus is calculated at 30 to 35 miles, and the velocity of motion of the wave particles as high as 30 feet per second. This being double that observed by Mr. Mallet in the great Neapolitan earthquake of 1857, the question arises why the loss of life and destruction of houses was so much smaller in India than in Italy? The cause must be sought in the different character of the architecture. In India the majority of houses are elastic structures of wood and bamboo. Those built of brick or stone are for the most part only one storey in height, and detached from each other.

We cannot avoid here repeating an old lesson, *i.e.*, insisting on the advantages in districts liable to earthquakes, of houses built of sheet-iron plates bolted together. To prevent rapid changes of temperature the walls may consist of double plates, with a layer of air between. Such houses would have, in addition, decided advantages in a sanitary point of view, and would not harbour snakes, rats, termites, and vermin in general.

Breeding Horses for Use. By F. Ram. London: Civil Service Printing and Publishing Company, Limited.

We felt at first slightly surprised that a book on such a subject should be sent to us for review. On turning over its pages we soon perceived that the author was taking up the matter from a novel, and decidedly rational and scientific, point of view. Mr. Ram's object seems to us, indeed, of no small importance. He seeks "to point out the irrationality of the present means of determining which particular horses are best to be employed in propagating their kind,—that is to say, for raising stock for useful purposes." In view of a variety of circumstances both at home and abroad, he contends that it is our duty to obtain from the farm-produce placed in the stable-manger the maximum amount of power obtainable from it. He shows that the amount of work to be got out of horses for an equal consumption of food varies. The object of rational horse-breeding is to obtain "from the same number of blades of grass or grains of corn as now yield only one foot-ton of work, a much larger measure of energy." He holds that horses should be judged not by their figure, or their power of "flying, lightly weighted, as fast as scandal, for a few moments, for the benefit of gamblers," but for their capacity for work, their power of endurance, and of bearing great fatigue, privations, and hardships: the horse which excels in these respects will be the best, whether for the road, the farm, or the battle-field, even if he should display what some authorities call "inferiority of figure and utter want of quality." He says, "How use and beauty may be in conflict is illustrated in the Californian mustang, described in the "American Journal" as a coarse-grained, ill-built, ugly, vicious brute, but invaluable on account of his never-to-be-played-out bottom and speed. With what favour would such an ugly beast be looked upon if it made its appearance at an English show?" How comes it, we may ask, that prizes have never been offered for the horse which can cover most ground in a day, or in a week? The answer, we fear, must be sought in the fact that such races would ill suit the class to whom the horse is a mere tool for gambling.

Mr. Ram's work deserves, from a national point of view, very careful consideration.

Remarks on Cattle-Plague Vaccination. Translated from the French of Dr. C. Pigeon, of Fourchambault. With an Appendix on the Inoculation of Goats with the Virus of Pleuro-Pneumonia. London: Vacher and Sons.

A few days ago the French nation, by their Parliamentary representatives, have voted almost unanimously to Prof. Pasteur a pension of 25,000 francs annually, with remainder to his wife and children. All the political parties seemed agreed, and the discussion raised by a few members was barely tolerated. In full opposition to this vote, Dr. Pigeon proclaims Pasteur's discovery a complete failure! Surely such a question as that of the efficacy or inefficacy, the safety or the danger, of a method of treating a given disease admits of being brought to an absolute decision! On the title-page of the pamphlet is given an extract from a speech of Dr. B. W. Richardson, F.R.S., in which we find these words:—"This manufacture of spic-and-span new diseases in our species is too much to endure the thought of, especially when we know that purity of life is all-sufficient to remove what exists, without invoking what is not." Very fine; but what definite, practical meaning are we to attach to the floscule "purity of life"? Taking the words in their sanitary meaning, we cannot forget that rinder-pest sometimes passed over cattle lodged in filthy, undrained, and unventilated stalls, to attack a herd in some model farm where every conceivable appliance was used to secure the absence of all foci of disease. We should like, therefore, some tangible instructions. As for the goats in South Africa, the sooner they are extirpated the better.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

NATURAL LAW IN THE SPIRITUAL WORLD.

To the Editor of the Journal of Science.

SIR,—It has remained for a Scotch theologian, Henry Drummond, F.R.S.E., in a book with this title, published by Hodder and Stoughton, to show, to his own entire satisfaction, that the discovery of unity in Nature limits the members of the kingdom of Christ to an astonishly select few. It is a pitiable work, not worth notice except that the title may in some few cases lead to waste of time.

To correspond with the spiritual environment, the author says, it is needful to die to the natural environment. The shortest way out of the difficulty (p. 180) would be to die at once and go to heaven; but, as this is not permitted, we must "die as much as we can," the task being limited to three steps—"Suicide, Mortification, Limitation." The author, who seems to be the impersonation of relentless bigotry, clutches, with an energy which is fearful to see, at a floating straw in the shape of a supposed analogy between Nature and some of St. Paul's words, which, as we know, are capable of being wrested to a purpose too sad to be dwelt upon. We are reminded of a Scotch dame who used to deliver herself thus:—"The true Kirk o' Campbell, as compared with the outer warld, is compact of my gude man and mysel', and I'm na that sure o' John."—I am, &c.,

H. H. H.

PS.—Can it be possible that we have here another specimen of a pious fraud, meant to frighten the Evolutionists? From a letter in the "Spectator" it would seem that the author of "Ecce Homo" had something of this kind of purpose in his more recent work on Natural Religion. Does Mr. Drummond believe his divinity, but not his science? Well, this would certainly account for some rather peculiar views that Mr.

Drummond has, notwithstanding his being F.G.S. in scientific matters.

OFFICIAL AND NON-OFFICIAL WATER EXAMINATIONS.

To the Editor of the Journal of Science.

Sir,—Premising that I have not the slightest respect for Water Companies, either in London or elsewhere, but look upon their establishment as one of the most serious errors of modern times, I must yet protest against the outcry raised in certain quarters concerning the analytical reports published on their behalf. It is, indeed, not easy to see who is the party really aggrieved, or what there is to complain of. Nobody, I presume, will doubt the competence of Mr. Crookes, and of Drs. Odling and Tidy, even if their results do not coincide with those of the official examiner. Nobody can deny that the Water Companies, if so disposed, have the right, like any private individual, to have their wares analysed, and to publish the results. Nobody, surely, except amiable enough to believe in the infallibility of the official examiner and the all-sufficiency of his very questionable process, can regret that the public should have the opportunity of hearing both sides of the matter. If the malcontent journals and individuals will have the kindness to point out where the analyses of Mr. Crookes, and Drs. Odling and Tidy are at fault, it will be quite time enough to demand that these reports should cease to appear, or that they should assume an aspect of "submissiveness."—I am, &c.,

W.

NOTES.

According to Prof. Du Bois Reymond the electric organs of fishes afford a curious instance of organic adaptation to the water which they inhabit. The electric ray, or *Torpedo*, living in salt water, requires but a slight electromotive power, and its organ consequently resembles a battery of few elements, but of large section. The electrical eel (*Gymnotus electricus*) and the *Melapterurus* of the Nile require a great electromotive force; hence their organs are batteries of many elements, but of small section. A comparison of the conductivity of sea- and river-water shows almost the same relation as exists between the electromotive force of the organs of the *Gymnotus* and the *Torpedo*.

M. Musset ("Comptes Rendus"), after prolonged observation, has never seen a single insect captured by the leaves of *Drosera rotundifolia*.

Dr. T. W. N. Greene states that he practised for four years in a province of Monte Video, where the population, practically speaking, subsisted entirely upon meat, and yet scurvy was unknown.

The "Popular Science News" says—"It is the tendency of all modern training to take for granted that beasts—and men—are all alike; and, if they be not, to try and force them to behave as if they were."

S. R. Canestrini ("Rev. Scient. Indust.") has been experimenting on the effects of decapitation on insects. Butterflies are able to fly eighteen days after being beheaded; crickets leap on the thirteenth day; and *Mantis religiosa* was still able to move on the fourteenth. The house-fly has even been observed to copulate after decapitation.

M. Robin ("Les Mondes") holds that syphilis, and even the venom of serpents, may serve as prophylactics against the malignant fevers of hot climates.

A French writer ("Les Mondes") says—"The meteor (Darwinism) has cast a momentary lustre; it will soon disappear in the darkness of oblivion."

A statue of Le Blanc, inventor of the manufacture of soda, is about to be erected at Issoudun, his native place. When living the world refused this illustrious chemist bread; now he has been long dead she gives him a stone.

Cattle are maliciously destroyed in India by wounding them with a spike moulded from the seeds of *Abrus precatorius*. Death follows on the second day. The pounded seeds, taken internally, have little action.

MM. Muntz and Aubin ("Comptes Rendus") consider that we are living on a stock of combined nitrogen produced at "the beginning," and that we are exposed to see this stock decrease unless the supply produced by the action of atmospheric electricity is a sufficient compensation.

Dr. Laborde (Société de Biologie) considers cinchonamine as excessively poisonous, even in very small doses.

According to M. Poëhl (Russian Chemical Society) almost all the tissues of plants and animals have the power of converting albumenoid matters into peptones.

At the August meeting of the Entomological Society was read a communication from Dr. Fritz Müller, from which it appears that the protection derived by insects from an evil odour is not absolute. The author had found about thirty specimens of a common and very offensive Brazilian species whose wings appear to have been perforated by the beaks of birds.

The same author also finds that the pupæ of Lepidoptera are not invariably modified in colour in accordance with the object to which they are attached.

Dr. F. Müller also observed that the caterpillar of *Eunomia eagrus*, when becoming a pupa, attaches itself to a twig, and fixes its stiff and venomous hairs to the twig something in the style of a bottle-brush, so as to prevent access to the pupa either from above or below.

At the same meeting was read a communication from Mr. W. H. Pryor, on the insects of the Island of Yesso. About 11 per cent of the species collected there occur also in Britain.

M. A. Fauvel ("Comptes Rendus") still upholds the doctrine that the cholera has been imported into Egypt from India, in consequence of the suppression of preventive measures. It is significant that the Academy of Sciences has ordered the insertion of this paper in the "Comptes Rendus" in full, though exceeding the usual limits.

A. Ritter ("Wiedemann's Annalen") gives the following propositions as the results of a mathematical investigation of the subject:—The superficial temperatures of two fixed stars of equal densities are approximately as the square roots of their masses; the surface temperature of the sun was never much greater, and can never become much greater in the future than it is at present. The masses of the white fixed stars are greater than the mass of our sun.

A medical contemporary refers to the opinion that on the approach of cholera to a district sparrows and swallows forsake it in a body.

According to H. Victor Meyer the colour-reactions of benzol are due to the presence of a small quantity of a body hitherto unknown, which closely resembles benzol, and to which Prof. Meyer has given the name of thiopten.

We regret to announce that the museums and laboratories of the Indiana University have been destroyed by fire, caused by lightning. The loss is estimated at 166,000 dollars, but many of the specimens cannot be replaced at any cost.

" Science " considers it probable that the Biscayan fishermen visited Newfoundland before the days of Columbus. It appears that when Cabot landed he found the natives using the Biscayan word " baccalaos " for salt cod.

M. Gabriel Rogeron (" Les Mondes ") recommends Bewick's swan for domestication, as being more beautiful than the common swan, and as taking up much less room.

M. C. Raveret-Watel, in the same journal, considers irrigation as the cause of a sweeping destruction of fish. The young fry penetrate into the channels, and perish when the current is suddenly shut off.

" Science " gives the following curious quotation from a book entitled " Eureka, or the Golden Door Ajar " :—" If sound travels by vibration, as Science teaches, and Science teaches that vibration creates heat, that if a cricket should stand on one end of a solid slab-stone and rub his wings together, why is it that the vibration with the particles of stone does not completely melt the stone in ten minutes ? I deny the hypothesis."

An " Entomological Congress," sparingly attended, was held at Paris on July 13th, in the Palais de l'Industrie.

After a turbulent discussion the French Chamber of Deputies has voted the proposed increase of M. Pasteur's pension to 25,000 francs annually, as a national reward.

According to M. Wroblewski (" Comptes Rendus ") the critical pressure of oxygen is 50 atmospheres, and its critical temperature $-113°$ C.

M. de Chardonnet has shown that persons deprived of the crystalline lens, by the operation for cataract, perceive the ultra-violet rays more readily.

A specimen (" Science ") of the American turret-spider (*Tarentula arenicola*) had been removed, together with its tower, the upper and lower openings of which had been plugged with cotton to prevent the escape of the inmate. On the arrival of the package at its destination the upper plug was removed, but the lower one forgotten, The spider, therefore, began to cast it out, but during this operation she perceived that it would make a good material for lining the tower, and accordingly applied it to that purpose. This is a clear case of invention,—the utilisation of a novel material.

Mr. A. S. Packard ("American Naturalist") considers the Phyloptera (Neuroptera, Pseudo-Neuroptera, Orthoptera, and Dermaptera) as the nearest approach to the primitive groups from which insects are derived.

Herr A. Mehring ("Gesellschaft Natur. Freunde Berlin") proves, from palæontological evidence, that wild horses existed in Europe as far back as the end of the Tertiary period, and that the modern horse is not, as commonly supposed, of exclusively Asiatic origin.

The question put by Mr. W. A. Gibbs,—"Are we to lose our future harvests?"—now that a remedy has been found successful whenever tried, is again being emphasised by the doubtful weather of the present summer.

According to Baron Mueller palm trees reach their extreme southern limit in New Zealand, where *Kentia sapida*, a noble species, extends as far as latitude 44° S. The most southern American members of this tribe cease in La Plata in lat. 34°.

Mr. S. N. Rhoads ("American Naturalist") gives a positive proof that the turkey buzzard (*Vultur aura*) is guided to its prey by scent.

Mr. T. McIlwraith ("American Naturalist") gives a good account of the misconduct of the European sparrow, both as to the damage which it commits in the fields and gardens, and as to the too often successful warfare which it wages against harmless and useful species of birds.

Mr. D. H. Talbot, in the same journal, gives an interesting account of a mare fetching some men to rescue her colt, which was entangled among some willow trees on the bank of a river.

HH. Assmann, Von Bezold, and Van Bebber ("Naturforscher") reject the cosmic theory of the cold weather generally experienced from May 10th to 13th.

GERALD MASSEY'S LECTURES.

Previous to his departure for America Mr. Gerald Massey is about to give a Series of Four Lectures,—Archaic, Evolutionary, and Theosophic,—addressed to "thinking men and women," the first subject being "Man in search of his Soul during 50,000 Years."

This Course of Lectures is advertised to be given on the last four Sunday afternoons of September, at 3 p.m., in St. George's Hall, Langham Place.

[The above Lectures do not come within our cognizance as far as their principal subjects are concerned. They will, however, we understand, discuss incidentally the origin of language and the transit from the brute to the human condition.—ED.]

ERRATUM.—In the article by O. Reichenbach in the August number, page 456, 4th line from top, $\frac{M}{D^2}$ should be $\frac{M}{D^\omega}$.

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THE

JOURNAL OF SCIENCE.

OCTOBER, 1883.

I. THE VELOCITY OF LIGHT.*

By O. REICHENBACH.

(Concluded from page 518.)

THE position of the centre of gravity of the earth, itself depending on the relation of mass of sea and earth, and so forth, determines the refraction of the elements constituting the atmcsphere.

The index of refraction of water is 1·336; of sea-water, 1·343; when we modify the latter figure according to the mean temperature of the mass of the sea, 1·351. It is—

$$0{\cdot}351 : 1{\cdot}351 = 1 : 3{\cdot}83.$$

The light entering the sea experiences a loss of velocity, which is to the velocity of continuation as 1 : 2·83 as the densities of water to land, or inversely as their extents,—which means that the velocity of light in the average solid is *zero*; the light is entirely turned into other forms of gravity, which the reader may fully comprehend at the end of this article.

The mean amount of "terrestrian refraction," "the curvature of a nearly horizontal ray, taking the earth's curvature as unity, is between $1 \div 5$ to $1 \div 6$," and it is supposed and calculated that this curving is due to the decrease of density of the atmosphere with height :—

$$(1 \div 333) \div (1 \div 59{\cdot}56) = 1 \div 5{\cdot}56$$

---

* Referring frequently to "On some Properties of the Earth" (Wertheimer and Lea: London, 1880) I designate it by o. s. p.

terrestrian centrifugality drives the vapour with an additional $1 \div 5{\cdot}56$ against the air decreasing with height in density.

To fully appreciate the causal connection of all quantities I mention one ought to have read "On some Properties of the Earth." I quote from page 103:—"We get—

$$(11200' \times 29{\cdot}78) - 11200' \times (29{\cdot}78 \div 5{\cdot}7) = 275{,}108 \text{ feet}$$

as height of the atmosphere."

"But this is not the true height. We must account for the increase of centrifugality through the 275,108′. It is $1 \div 40$ (of the $1 \div 333$). This loss of gravity is diminished by the mass itself of the atmosphere between its limit and the earth, adding to the attraction of the latter. The whole loss so becomes—

$$1 \div 40 - (1 \div 333) = 1 \div 44{\cdot}63,$$

and the height of the atmosphere—

$$275{,}018' + (275{,}018' \div 44{\cdot}63) = 280{,}913', \text{ or } 6162' \text{ more."}$$

The 6162′ are thus reduced $1 \div 29{\cdot}78$, to 5956″, &c.

And page 107:—"The height of the atmosphere is 278,172′, with the imaginary equivalent 281,065′." . . . . "If the outer atmosphere were composed like the inner one it would be—

$$(5956' \div 281{,}065')^2 = 1 \div 2186$$

of the mass of the atmosphere; as it is constituted we find it to be $1 \div 1655$. It is $1 \div 1655$, not $1 \div 1713$, because at its distance from the earth the attraction of the sun has increased and that of the earth decreased, so as to produce a difference of $1 \div (1713 \times 29{\cdot}78)$."*

Knowing, then, the height of the atmosphere and the velocity of light censed *in vacuo*, we know the time it takes for the light vibration to travel through that height, and we find the proportion:—As the height of the atmosphere is to the distance of the generator (or reflector) *in vacuo*, so is the time light requires in travelling through the atmosphere, as it is in the mean here below, to the time censed to be spent on the whole distance. When distance changes time changes.

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* 278,172′ is about the figure of Bradley and Delambre. Certain modern astronomers suppose the height much greater. They seem not aware that their observations were made, and their reasons propounded and refuted, in the first quarter of this century.

The velocity of light with regard to the individual earth depends therefore on the quantities and qualities of the medium atmosphere, themselves subject to the interaction of earth and sun.

So little as light is heat, but both are intimately connected, so little are light and radiant heat identical: light therefore ends where we cease to see it in the spectrum; no thermometer, thermopile, or bolometer is made for it, but the eye is. Absence of light begins on the side of the red, where the uniform motion gets deviated, delayed, and divided by resistance, when the rotatory tendency of molecules exceeds that of vibratory propagation of transport or or orbital motion in the mass; darkness begins on the side of the violet, when the solar opposition and impulse against terrestrian and molecular centrifugality is so diminished by interposition in and deviation from its straight path, and the number of molecular vibrations so increased and the length of waves so reduced, that an altered polar action introduces new molecular combinations.

Any more or less diaphanous substance, or made diaphanous by change of state, being a distinct medium, produces a spectrum of its own, according to its gaseous, liquid, or solid state, the aggregational and the internal state of its molecules, and its changes in temperature, pressure, and form. Any such medium introduced into the atmosphere therefore modifies the atmospheric spectrum; but the atmosphere, air and water-stuff, is the true medium of light, the instrument formed by earth and sun for their use, and all other substances coming and going in it in small quantities are instruments that have to submit and fit in the atmospheric orchestra and its pitch, and to equalise and absorb their characteristics in the unity of harmony. The solar spectrum is the atmospheric spectrum, all kinds of molecules being there and here represented.

It follows from day and night, from the undulatory theory, that the scale of wave-lengths in this spectrum cannot surpass the scale $1 : 1 \div 2 = 2 : 1$, from darkness to darkness. Angström found the wave-lengths of line A 760·4 millionth of a millimetre, and of H_2 393·3, which gives for a metre for A 1,315,100, and for H_2 2,542,500 lengths.

"Not only the darkness of A and B, but their appearance depends on the relative position of the sun, on his being near the horizon"; "they are called entirely atmospheric." So it is with H_2; A will be more prominent in the morning, H_2 in the evening. "Janssen has even succeeded in producing, by absorption of vapour of water, black rays near

B and C and D," says Angström, who observed in high latitudes, during intense cold, that "certain telluric rays" disappeared, others became prominent (vapour rapidly absorbed by the sea o. s. p.). He found "A about 13 units broad,"—that is, 1-59·56 of its 760·4 (morning), and "many of Frauenhofer's rays are double rays."

H_2 and A are not the limits of darkness; the lengths of their waves are 393·3 : 760·4 = 1 : 1·9334, but the ratio of the limit lines identical with incipient darkness must be two. It is 2·000 − 1·9334 = 0·0667 and 0·0667 ÷ 2 = 1 ÷ 29·78, as all water-stuff of the mass of the atmosphere, and the change in solar distance, &c.

The wave-lengths must have a cause; there must exist a definite measure whose length represents a certain number of waves for white light as unity, and when broken up in all colours of the rainbow for these divisions. That measure can only be the mean height of the atmosphere.

The ascending and descending water-stuff, in mass to air 1 : 28·78, describes in the resisting medium between earth and atmosphere curves of every height, resting their branches on every basis up to a quadrant. The curves are parabolas having the sun for directrix, the vertex of the curve moving with the apparent position of the sun and the real position of the revolving earth and her strata. On the side of the earth towards the sun the attraction of sun and earth are opposed; the sun carries matter from the earth; on the other side the two masses join in bringing back lifted mass, the action of the sun being, however, weaker by greater distance.

The air developes in itself centrifugality, tending to increase its height: this action, being a pressure against the sun on the day-side is opposed by his centrifugality; the centrifugal portion of the air is forced to describe curves having their vertices towards the earth, the air becoming in itself divided in hyperbolas having their foci in the centres of sun and earth. On the night-side, when both attractions join, all the curves become parabolas,—water-stuff and the centrifugal 1 ÷ 44·63 of the air tending more to descend, and the general air, as representative of the mean centrifugality of the earth or sea, to ascend; warm air ascends when cold air and water-stuff descend. Where contention of sun and earth exceeds there is day, where coaction exceeds is night.*

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* Meteors may become lighting outside the atmosphere, through increase of outside influences accelerating their translatory and rotary motion, and developing round them a liquidity and atmosphere of their own.

The opposing curves, representing contending forces, must, like all arrested motions, produce beside the actual transport of particles mass vibrations, conflicting contacts, waving of molecules wholly and in their own strata, characterising the particular molecules engaged.

The length of these waves being determined by the ratio of the contending forces, the diameters of the vibratory curves, the possible extent of their angular combination, or the relation of equatorial and mean centrifugality of the whole revolving mass and medium, which is by opposition continually in polar motion antagonistic to increase of centrifugality. The number of wave-lengths in direct white light not diverted and decomposed is therefore equal in the whole height of the atmosphere.

$$\frac{\begin{matrix}\text{Solar}\\ \text{Distance}\end{matrix} \times \begin{matrix}g\text{ at Surface}\\ \text{of the Earth}\end{matrix} \times \begin{matrix}\text{Pressure 1 of}\\ \text{Atmosphere.}\end{matrix} \times \begin{matrix}\text{Centrifugality}\\ \text{at Equator to }g\end{matrix}}{\begin{matrix}\text{Height of}\\ \text{Atmosphere}\end{matrix} \times \begin{matrix}G \div R^2\text{ of Sun}\\ \text{at that Surface}\end{matrix} \times \begin{matrix}\text{Centrifugality developed}\\ \text{in Atmosphere.}\end{matrix} \times \begin{matrix}\text{Mean Centrifu-}\\ \text{gality to }g.\end{matrix}}$$

Or—

$$\frac{\text{Radius}}{\text{Cos } 30^\circ.}$$

Formula *b*:—

$$= 1,789,242 \times 1713 \times 44{\cdot}63 \times 333 \div 289;\ \text{or } 1{\cdot}149;$$

which divided by 84,500 metres, the height of the atmosphere, gives to the metre 1,849,242 wave-lengths in the verse and transverse sense, and 540·7 mth. m.m. as length.

A and H_2 are not the limits of darkness; we get them on the side of the red by multiplying the 540·7 by $\sqrt{2}$ with 764·5 mth. m.m., and on that of the violet by dividing the 540·7 by $\sqrt{2}$ with 382·4 mth. m.m.; that is, respectively multiplying and dividing the 44·63 in formula *b* with $\sqrt{2}$.*

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* Thinking that the last breaking-up line of white light, or the interference of the completely unequalised wave-lengths, representing the oscillating diameter through the vertex of the mean of all water-stuff curves mediating between actual transport and vibration of mass, must be a prominent line, I expected to find it in E, with 526·9 mth. m.m. wave-length or 1,897,000 waves to a metre, which itself, or whose immediate neighbourhood, divides the extent of the spectrum beginning from the side of the violet as 1 : 1·69, as the density of vapour to that of air, o. s. p. It does, however, not correspond to the wave-lengths of A and H_2 when the scale of 2 and the ascent and descent with $\sqrt{2}$ is maintained, and would, applied to formula *a*, increase solar distance, making the velocity of light 309,910,000 metres. The line is, however, not without particular interest.

Angström says "E has served me as a start in my micrometric measurements," without telling us why; "there are *really two* E's; it appears a dividing ray; but it is impossible in spectra of a high order to get a distinct and direct image of the double ray." He speaks of getting 1·4 units more

The correctness of the result obtained for the velocity of light by formula *a* depends on the correctness of the single terms, of which solar distance is the most uncertain.

I took $g = 9{\cdot}8088$ metre (Paris), a correction (not plain latitude) being trifling, for radius of the earth, 6,369,829 metres, or quadrant 10,000,000 metres. For height of the atmosphere $1 \div 75{\cdot}4$ of the radius, according to passage quoted from o. s. p., and for solar distance 23,730 radii, as appearing from the compressibility of the sea (see before), and from other reasons (mean motion in orbit 30071 metres in second), or—

$$23730 \times 75{\cdot}4 \times 84500\,m = 1789242 \times 84500\,m =$$
$$= 151{,}190{,}949{,}000 \text{ metres} = 94{,}900{,}000 \text{ miles},$$

about the *old* figure. Which brings the velocity of light through formula *a*, 305,686,029 metre a second, in complete agreement with the results of *b*.

Having long ago characterised electricity as resulting from a disturbance in the distribution of weight in certain strata of opposite hemispheres of mass and molecule, and since then shown in o. s. p. the part played with regard to our planet by a hemispheric inequality of $1 \div 29{\cdot}78$ of sea, atmosphere, and solid, answering to the inequality of solar distance, I pass on to Clerk Maxwell's hypothesis of the electro-magnetic nature of light.

He about says :—When V, the quantity expressing the velocity of propagation of electro-magnetic disturbance, is numerically equal to *v*, the number of electro-static units of electricity in the electro-magnetic unit, light is an electro-magnetic disturbance propagated in the same medium if V equal to the velocity of light. "Hence the agreement or disagreement of the values of V and *v* furnishes a test of the electro-magnetic theory of light." He then gives the following table :—

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by grating 3 than by 2, and 1·4 units less by grating 2 than by 4, and sees no reason but a less appropriate construction of 3 and 4.

The difference between the 540·7 and 526·9 mth. m.m. is only 13·8 units. Angström speaks of a double ray, and allows for the coming and going a width of 13 units, and the wave-lengths of H_2 as found vary more than 3 units. When we deduct 1·4 unit from the 13·8, making them 12·4, they are the $1 \div 42{\cdot}6$ of the 526·9. There is undoubtedly much that is oscillatory about all quantities connected with light, as the quotients of $\frac{G}{R^2}$ into *g* vary, the outer atmosphere is a compressor, the atmosphere is not of equal height, and we have from bottom to top within the atmosphere between solar and terrestrian gravity the prominent relations $1 \div 1773$, $1 \div 1713$, $1 \div 1743$, $1 \div 1655$, &c.

Velocity of Light, metres per second.		Ratio of Electric Units.	
Fizeau ...	314,262,944	Weber ...	310,740,000
Aberration and Parallax .	308,000,000	Maxwell ...	288,000,000
Foucault ...	298,500,000	Thomsen .	282,000,000

To which the results of more recent experiments and determinations of parallax might be added; there is plenty of choice within certain limits.

Clerk Maxwell made the ohm 1 ÷ 28·8 of V, or, without being aware of it, as the mass of water-stuff is to that of air in the atmosphere, or the mass of salt to that of water in the sea.

The first determination of the ohm was confusing. "A body," "which in one second travels along a meridian from the pole to the equator, would have a velocity which on the electro-magnetic system is professedly represented by an ohm," the distance from pole to equator being "professedly" "10 million metres, or 10,000 kilometres." Maxwell said "professedly," "because velocity and distance may not be quite correct."

The meridian of Paris has been found to differ, the equator is no circle, and the shape of the earth and the distribution of gravity is not without farther complications; but any meridian from pole to equator has its companion, and they have their pair; the hemispheres are not of equal size; the greatest difference of two meridian semicircles is about 22,000 metres, and in the mean the circumference of the earth is about 40,000 kilometres.

Strange would it have been if a resistance which expressed as a velocity "professedly" represented the distance from equator to pole should be overcome in exactly a solar second, an arbitrary measure of time, sprung from the arbitrary division of a curve. For the division of the circle and the day are coeval; the not quite concordant divisions were a convenient and mystic compromise between the decimal system for the rigid mathematical figure and the more or less duo-decimal system in the motions of the most observed heavenly masses with regard to our earth.

The ohm is now determined 9413 kilometres, a velocity which would lead round the 40,000 kilometres in 4·248 secs. To the electric current moving from pole to equator and pole corresponds the magnet moving in transverse direction.

The mass of vapour continually lifted into the air by the sun is 1 ÷ 333 × 1 ÷ 59·56 = 1 ÷ 19833 of the mass of the sea, containing 1 ÷ 29·78 of its weight in salt, led about by the sun ; these masses of conducting stuff, water in the air, salt in the sea, each in its comparative non-conductor, are moving wires round the earth, equally rich in iron, &c., o. s. p.

The earth turns round her axis in 23 hrs. $56' 4{\cdot}09'' = 86{,}164''$; $86{,}164'' \div 19833 = 4{\cdot}344''$. As the mass of the conducted vapour lifted out of the salt sea into the dielectric air by the sun is to the mass of the conducting sea, so is the vibratory velocity of conduction round the earth through the atmosphere to one revolution of the conductor, the sea,—or rather the salt in the sea—round the earth with the earth.

$4{\cdot}344'' - 4{\cdot}284'' = 0{\cdot}096''$ reduces the 9413 kilometres to 9202. It is $9413 - 9202 = 211$, and $211 \times 9413 = 1 \div 44{\cdot}63$, the centrifugal development through the whole of the atmosphere is a variation disregarded in calculations.

The lifted water, always representing with its descending branches the $1 \div 29{\cdot}78$ of the atmosphere, moves within the 28·78 times greater dielectric mass, and when we multiply the 9202 kilometres by 28·78, the very factor of Maxwell, we get for the electro-magnetic unit 264,833,560 metres, the process in the sea being the respondent, and the vibration through the earth the analogon.

When we multiply the 28·78 terrestrian mass resisting the 1 of mass appropriated by the sun by the surface of the earth, the magnet-stuff surrounded by the rings of water and air, we get, r being 1, $28{\cdot}78 \times 4\pi r^2 = 361{\cdot}649$ revolutions during one revolution round the guiding sun. When we divide the $4\pi r^2$ representing the resisting terrestrian surface by the percentage of mass actually transported by the sun in the resisting terrestrian mass, to the sum of both masses $4\pi r^2 \div (1 \div 29{\cdot}78)$, we get 374·215 revolutions. The actual number of revolutions being 365·25, the first result is 3·607 revolutions in default, the second 8·966 in excess.

The revolutions being constant during the year and equal amongst themselves, the retardations and accelerations must compensate each other, power against time, so as to maintain these twofold uniformities amidst the changes of solar distance, and under the influences of other bodies within and without the solar system acting directly and indirectly through the sun on the earth. The following are the chief ones of these differences embracing all others. It is retardation to acceleration,—

$$3{\cdot}607 : 8{\cdot}966 = 1 : 2{\cdot}49 = 2{\cdot}5,$$

as solar to lunar tidal action; the moon, more opposing than assisting solar tidal action, therefore maintains the equilibrium. That this lunar action is turned inductively through the sun into electromagnetic action may be seen in o. s. p., where I speak of Allan Brown's observations in chapter "Terrestrian Magnetism."

3·607 is the 1÷101 of the year = (1÷6106)÷(1÷59·56). The divisor represents the ascending vapour in the air and salt in the sea, the vibration from the centre through the solid, the $\surd$ of the eccentricity of the earth, and the eccentricity of her orbit; the dividend the decrease in solar attraction through the diameter of the levelled solid of the earth, without sea, normal to the orbit. This quantity varying with solar distance, and ex- and inclusive of depth of sea and height of atmosphere, negative to terrestrian attraction on the dayside, and positive on the nightside, amounts for the whole sphere or neutrality to—

$$4\pi r^2 \div (1 \div 6106),$$

and for each hemisphere as negative or positive to—

$$2\pi r^2 \div (1 \div 6106).$$

The 8·959 revolutions are the 1÷40·76 of the year, the proportion of the own centrifugality of the atmosphere, exclusive of its diminution by the own mass of the atmosphere, and $40{\cdot}76^2 = 1655$; the 1÷1655 being o. s. p. the mass of the outer atmosphere to that of the atmosphere. The outer atmosphere is a compressor of essentially electro-magnetic nature, without vapour of water, induced by the polar action of the earth and the centrifugal and co-attractive action of the sun to special molecular combinations, determined in quantity by the difference of quotients of solar into terrestrian attraction at the top and bottom of the atmosphere and over sea and land, &c.

"It is manifest that the velocity of light and the ratio of the units are quantities of the same order of magnitude," but it is also evident that they are not identical.

The vibratory motion caused by the conducting vapour moving from equator to pole by alternate action of the sun and of the earth, as constituted in the course of time by that inter-action, is resisted by the centrifugal motion of an already determined portion of the air from pole to equator, which makes its motion vibratory, electric, the sea emitting and absorbing both vapour and air, the one preferentially in equatorial, the other in polar regions o. s. p. The resistance therefore is—

Velocity of absolute centrifugality at the surface of the earth.

Equatorial centrifugality to g, the $1 \div 289{\cdot}5 + [(1 \div 24{\cdot}16) \div (1 \div 289{\cdot}5)\ (= 12{\cdot}08)] = = 1 \div 303$, one polar region being the $1 \div 24{\cdot}16$, both the $1 \div 12{\cdot}08$ of the sphere, &c.	×	$1 \div 3{\cdot}83$, the polar arc to the quadrant or the surface of the land to that of the earth, &c., a comparative insulator in the sea, projecting as insulator into the atmosphere with a mean height, &c., o. s. p.

7933 metres $\times 303 \times 3{\cdot}83 = 9{,}202{,}000$ metres, the ohm which, multiplied by the $28{\cdot}78$, gives $v = 264{,}813{,}560$ metres.

Heat is transformed into electricity and electricity into light, sunlight becomes heat and heat turns electricity. It remains to show why the 305,686,092 metres of the velocity of light are reduced to V.

The sun lifts the water-stuff from sea and land in a more elastic uniform outside stratum, and leads it in doubly alternating opposition and conjunction in a maintaining polar process, resisting to the tendency of absolute centrifugal dispersion, in the direction from equator to pole. The water-stuff, by its orbital and rotary motion resisted by the air, becomes the real distributor of light and heat, the equivalent of light and heat itself.

Electricity is a continual derangement and re-arrangement of a constitutional inequality in the hemispheric distribution of mass in masses and molecules. Vapour- and water-stuff generally are, by their constitutional qualities, neither prominent generators nor conductors of such derangement, but they are worse generators and better conductors than air; and so with salt, dissolved to brine, with regard to the water.

Moving through the air the vapour, not unassisted by other substances, produces that frictional and chemical derangement (the electric half) in the air, and conveys it, itself deranged by reaction, as other half, for re-arrangement back to sea and land, turned in form to ice, drops, vesicles, and electro-magnetic vapour.

The sea, with all its generating and conducting nerves penetrating through air and solid, is so shut up between the dielectric wrapper, air, itself housed in the outer atmosphere, and between a solid shell less conducting than the sea or inner earth. It acts as moving conductor wound round the nucleus saturated with iron. Each stratum thus has its own motion according to its molecular constitution.

When light and radiant heat, primarily as gravity two in one, are transformed in the air into electro-magnetism, it therefore means that the vibratory motion has to lose in velocity of propagation or power, a proportion equal to the number of times the mass and substance, the vapour, the equivalent of light and radiant heat, has to be renewed, lifted, and thrown within a certain time by the limited amount of propelling solar force, struggling with terrestrian force.

I have shown in o. s. p. that the water-stuff in the air is annually renewed 7·78 times, its mass passing through the atmosphere representing $1 \div 29{\cdot}78 \times 7{\cdot}78 = 1 \div 3{\cdot}83$ of the mass of the latter, or the so manyth part as the polar arc to the quadrant, or the surface of land to that of the earth, &c.

It is $A - v =$ 305,686,029 metre $-$ 264,813,560 metre $=$ $=$ 40,872,469 metre, which is not the $1 \div 7{\cdot}78$, but the $1 \div 7{\cdot}5$ of A. Assuming v more certain, A would have to be reduced by 1,814,421 metres to make the difference $1 \div 7{\cdot}78$ of A. Not believing the A obtained (or rather the solar distance introduced in formula *a*) so much at fault, my line of thought, represented in o. s. p. (where also see about the substances not water or air in the atmosphere), led me to see that $1 \div 7{\cdot}5 - 1 \div 7{\cdot}78 = 1 \div 170 = (1 \div 44{\cdot}63 \times 1 \div 3{\cdot}83)$, figures defined and here denoting that the height and centrifugal development of the air over sea and land are not identical.*

I mean to have proved that much of what is and what must be universal quality of matter depends quantitatively for the earth on the individual earth.

This fact and the variety in the most careful measurements suggest that the velocities A and V constant *in their mean* for the earth and year as united quantities, must be in inverse order variable amongst themselves according to solar distance and every division of place and time, and that any oscillation must become more apparent when short distances are the bases of measurement than when light is due to direct action from outside the earth. Such oscillation could not exceed—

$$1 \div 12{\cdot}08 - 1 \div 29{\cdot}78 + ((1 \div 12{\cdot}08 - 1 \div 29{\cdot}78) \times 1 \div 59{\cdot}56)) = \\ = 1 \div 20 \text{ of the maximum velocity.}$$

The two earliest, and at the same time most divergent, experimental determinations, Fizeau's and Foucault's exceed only by 50,000 metres the proportion 20 to 19. My figure holding not quite the middle is, as it should be, somewhat nearer the minimum figure. Two or all three figures may not be quite correct, but it can be shown that the differences stand in a regular relation to the $\sqrt{1} \div 1655$, $\sqrt{1} \div 1713{\cdot}9$, $\sqrt{1} \div 1773$, &c.—that is, to the inverse squares of the quantities expressing the various leading relations of solar to terrestrian gravity at the surface of the earth and through the atmosphere.

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* In o. s. p. and in the Journal of Science, "An Idea of Lord Bacon's," 1881, may be seen that there exist certain waves in sea and land, most discernible in the formation of the latter, starting from the south pole, propagated into the atmosphere, which present the relation $90° \div 7{\cdot}78 = 11°44'$, and that $3{\cdot}83 \times 2 = 7{\cdot}66 = \sqrt{59{\cdot}56}$, leads to waves 11°40′, to a difference of 4′, which transposed into time, 4·06′, is to the day as the day is to the year, &c.

II. THE DECEASED WIFE'S SISTER'S QUESTION: RATIONAL MARRIAGE-LAW.

IT may at first glance appear strange that we should here discuss a subject commonly regarded as falling mainly within the province of divines and jurists. We submit, however, that the entire question belongs solely and simply to the physiologist, and that as such it may with perfect right be considered in the "Journal of Science."

The first rudiments of a Marriage-Law—that is, the first restrictions on union between any two individuals of opposite sexes—have to be sought in the vegetable world. All those most interesting arrangements described by Darwin and others, tending to prevent self-fertilisation and ensure cross-fertilisation, are an unwritten but effective law for keeping apart those who are too near of kin. This law is self-executive: seeds which have been fecundated by the male element of a strange plant, or at least by that of another flower of the same plant,—which is substantially another individual,—germinate more freely, and give rise to more vigorous plants, than such as have been from any cause fecundated by the pollen of the flower which produced them.

If we pass to a consideration of the animal world we cannot fail to note a number of arrangements which tend to frustrate, or at least to render unlikely, sexual intercourse between kindred. Even among hermaphrodites, such as the slugs, self-impregnation is impossible, and the mutual action of two individuals is required. Where the sexes are distinct, we find manifold provision to ensure the mating of males and females which are not respectively born of the same parents. Thus in the case of the solitary wasps and bees, though in some species the mother deposits her eggs in a single excavation in the trunk of a tree, or in a post, yet the larva which first reaches maturity flies away in search of a mate, as do the others in succession, and it is thus rendered exceedingly improbable that any two of them should meet again.

Since experiments have been made in India on the production of silk from certain so-called "wild" moths, of the genera *Bombyx*, *Attacus*, &c., it has been found that the males, on issuing from the cocoon, do not attempt to have intercourse with the young females, their sisters, but fly away. In their place stranger males arrive, and immediately set about copulation.

Another important agency to prevent in-breeding is that young animals, as they approach maturity, become less and less gregarious. Sometimes they separate spontaneously, and in other cases they are driven away by their parents, dispersion being thus effected.

Many kinds of caterpillars, even though up to that point they may have lived in large societies, all the descendants of one mother, yet when about to assume the pupa state set out on their travels, and often stray to a considerable distance from the plant upon which they feed. In many kinds of birds the two sexes seem during the winter to form distinct societies, and only seek each other up in the spring. In some migratory species the males and the females often arrive in separate flocks, at an interval of a few days—a habit which must render the pairing of brothers and sisters exceedingly unlikely.

These few instances, which might be greatly extended from facts already on record, and still more so from a special and closer study of the subject, prove that there exists a Marriage-Law throughout the organic world, the object of Nature being evidently that every female shall be fecundated, if at all, by a male of different blood. Consanguinity is the only bar recognised, and the one object to be avoided is degeneration.

From the lower animals we pass to man. Here it is proved beyond doubt that consanguineous marriages lead to a deteriorated offspring. Among the pernicious results deaf-mutism is one of the most common. Recent investigations show that in Berlin this affection is rare among adherents of the Roman Catholic faith, much more common among Protestants, and exceedingly common among Jews. The question was naturally raised how the religious persuasion of a married couple could conceivably affect the liability of their offspring to deaf-mutism? The answer was not difficult to find: the Catholic church does not permit intermarriage between cousins, we believe even to the third degree. Among Protestants the same laxity prevails in Germany as there does in England, whilst among the Jews such marriages are not merely tolerated, but even encouraged, possibly for the sake of keeping the property of a family together. The result is the more serious as throughout Europe the Jews, from the obedience which they still render to the admirable sanitary laws of Moses, have in many respects a higher standard of health than their Gentile neighbours.

Assuming it, then, as a known fact that consanguineous marriages are racially injurious, we need not wonder that from a very remote age—probably from the pre-historical days—laws and customs prevailed for the prevention of such unions. The bewilderingly complex Marriage-Laws of many savage tribes (*e.g.*, of the Australian aborigines), whatever else they may effect or purpose, have at least the result of compelling every man to marry some woman not of his own kindred. The like must have been the consequence of marriage by capture, traces of which survive even among civilised communities. In man, then, as among his "poor relations," the objection to the intermarriage of any two individuals is the prospective probable deterioration of the race. In him this became a conviction founded on recorded experience and couched in words. Among the lower animals it was, where not dependent upon circumstances beyond the knowledge and control of the individual, what is commonly called an "instinct."

But in mankind, unfortunately, the principle early became adulterated. The rational limits which Nature places to marriage were relaxed in some directions and narrowed in others. The relaxation has consisted in permitting the intermarriage of cousins, which is now unfortunately sanctioned in all civilised communities except where the Catholic religion is acknowledged. This serious practical error was probably due either to covetousness—the desire to re-unite portions of an estate which had been divided among the sons of a former possessor—or to a pseudo-aristocratic sentiment. Thus the ancient Peruvian incas enfeebled themselves by constant intermarriage with blood relations, and thus, to a minor degree, several of the royal and many of the noble families of Europe have married within a circle so narrow that degradation, bodily and mental, has been the result.

While on the one side injudicious and harmful relaxations of Nature's marriage-law have thus crept in, there have occurred on the other hand increased restrictions equally injudicious. Ecclesiastics and lawyers, not recognising the object to be kept in view, have added to the plain notion of consanguinity that of affinity, and even in the Middle Ages that of so-called "spiritual relationship."

The Catholic church, whilst wisely prohibiting the intermarriage of cousins, unwisely and needlessly forbade the union of persons connected merely by affinity,—*e.g.*, that of a man with the sister of his deceased wife. She even went a step further, and declared that a man and a woman who had both been sponsors at the baptism of the same child could not lawfully marry. What might be the motive for so strange a regulation, or what supposed evil it was intended to prevent, we are unable even to guess. But it appears that at one time a man might have no small difficulty in meeting with a woman whom he might legally marry unless he could either obtain a dispensation or seek for a wife in some remote part of the country. Hence much hardship arose, and doubts frequently arose as to the legitimacy of the descendants of certain marriages.

Still the Catholic church, if wrong, was at least consistent. She forbade marriage between relatives entirely, and if we grant that persons connected by affinity or "gossipry" *are* relatives, she is in the right; but this is the very point which we deny.

We Englishmen in this particular have held fast to our national character of inconsistency. We have prudently abolished spiritual relationship as an impediment to marriage, but we have retained affinity even whilst making serious inroads upon the fundamental principle of blood-relationship.

Hence when the "Marriage-Law Defence Union"—a body formed to oppose the Deceased Wife's Sister's Marriage Bill—say, in an advertisement, "The whole principle on which the Marriage-Law of this land is based is involved in the acceptance or rejection of the Deceased Wife's Sister's Bill," they venture on a very wild statement. The Marriage-Law of this land is based on no principle. It is a medley of enactments arbitrarily thrown together, and having no vital connection. It tolerates what it should forbid, and it forbids what it should tolerate. If we analyse the table of prohibited degrees, as appended to the Prayer-Book, we find grades of consanguinity and affinity not shown separately, but mixed together as though of equal significance. Nay, whilst ten degrees of consanguinity only are specified as constituting a bar to marriage, the degrees of affinity excluded are twice ten, as if to show that, in the opinion of the framers of this table, affinity constitutes a more important impediment than consanguinity!

The advertisement above quoted continues:—"In all countries where the Marriage-Law has been relaxed in this one particular, other relaxations have, after some lapse of time, been adopted; in some countries not only may a woman marry her [deceased] sister's husband, and a man marry his [deceased] brother's wife and [or] his wife's niece, or, as in the State of New York, his wife's daughter, but in others a man is freely permitted to marry his niece by blood."

The writers of the lines just quoted evidently fail to recognise the difference, *toto cœlo*, which exists between consanguinity and affinity, or they would never speak of marriage with a niece by blood being a relaxation likely to spring from sanctioning marriage with a deceased wife's sister. If, like ourselves, they would protest against the intermarriage of uncle and niece, they should remember that this is merely an extension of the "relaxation" which already exists in England,—the permission for the intermarriage of cousins. The advocates of the Deceased Wife's Sister's Bill are more or less consciously moving in a direction which will give the English Marriage-Law a definite principle. Not a few of them, whilst seeking to expunge all prohibitions based upon mere affinity, aim at securing for the law a definite physiological basis by forbidding the marriages of cousins. They aim not at laxity, but at a rational consistent strictness.

Of this we may be sure, that if marriage with a deceased wife's sister be wrong, it can be wrong only in virtue of evil consequences, just as drunkenness is wrong because it ruins the health of the drunkard and of his descendants. Let, then, the "Marriage-Law Defence Union" bring forward, if they can, facts, vital statistics. Let them show, if they can, that the issue of such marriages is more liable to deaf-mutism, blindness, idiocy, insanity, consumption, scrofula, &c., or that they have a greater tendency to crime than the average of their neighbours, countrymen, or contemporaries. Let them supply such evidence as this, and no one would be more eager for the maintenance of the existing law in this respect than ourselves. But in this direction, let it be noted, they have made not the slightest effort: none of the speeches made in Parliament or elsewhere against the Deceased Wife's Sister's Bill, none of the advertised publications of the Marriage-Law Defence Union," seek to show that such marriages have had, or are even likely to have, any effects hurtful to the individual or to the race. The list of patrons, vice-presidents, and committee-men which they publish contains the names of many persons of consideration,—prelates, peers, judges, members of parliament, military and naval officers, but not medical or physiological authorities. This seems to us a token that the Union ignore the only kind of argument which we can accept. The publications or tracts which they advertise, and which from their prices are evidently intended for distribution, contain in like manner the opinions of eminent lawyers, statesmen, and ecclesiastics,—a class of evidence which we must set aside as totally irrelevant. "What the Bishop of London says," "what Scotchmen say," "what the Roman Catholic Church says," &c., is all beside the question, and can merely serve to divert public attention into a wrong channel. Those indeed who, tacitly at least, sanction the intermarriage of cousins, demonstrably injurious, and yet hesitate about or oppose the Deceased Wife's Sisters Bill, are indeed straining at the gnat after swallowing the camel.

A rational table of "prohibited degrees," based upon the results of modern Science, might be drawn up in very brief compass. It would simply enact that no intermarriage might take place between descendants of the same father, mother, or both, between descendants of the same grandfather, grandmother, or both, and between descendants of the same great-grandfather, great-grandmother, or of both. This would bar all unions between blood-relations as far as second cousins inclusive, whilst all cases of mere affinity would be excluded from its operation.

Still this table would not complete the Marriage-Law of the Future. It must, in addition, contain stipulations against marriages being contracted not merely when the parties are *below*, but also *above*, a certain age,—a point upon which the laws of all nations have hitherto been silent, but which, if Mr. Francis Galton's art of "eugenics" is ever to become a reality, will also have to be taken into consideration in mankind as it is in the more valuable domestic animals.

Those in whom chronic disease or insanity is manifest will likewise be recognised as unfit for marriage.

By dint of such regulations, to which the world will ultimately be driven, the race will be ennobled, and there will be no weaklings produced to be trodden down in the "struggle for existence."

III. ON SANITARY REFORM.

By Rev. S. Barber.

WHETHER the present system of appointing Medical Officers to Public Boards is the only practicable one, or not, we need not now discuss, but I will merely remark that it would not be easy to conceive of a worse, the evils that attach themselves to it being unmistakable—"gross as a mountain, open, palpable." Two cases are in my mind as I write: one, that of a medical man who has, for some extraordinary crotchet, systematically opposed the efforts of the more intelligent inhabitants of the town to procure the sewering of a place of nearly 10,000 population (still unsewered); the other, that of an officer of a Local Board who is a notorious drunkard, and shamefully ill-treats his own child. It may possibly be said that such cases are quite exceptional, and that every effort is made to ensure satisfactory appointments. However this may be, to pass to another point, it can hardly be disputed that the selecting for Officer of Public Health one who has a personal interest in the continuance of disease is not a rational selection. We may ask, How is the income of a medical man to be estimated except by reference to his receipts,—in other words, the *cases of sickness* upon his books? And if any diminution of the number of such cases represents a diminution of the capitalised value of his medical goodwill, such decrease means so much pecuniary loss to the doctor.

Clearly, then, it is at once irrational and adverse to the interests of the public to appoint, as Medical Officer to a Public Board, a physician in practice in the district presided over by such Board; for if in his *public* position he has proved himself energetic and successful in the improvement of public health and the reduction of disease, he has extracted by his philanthropy so much money from his own pocket. It is evident, indeed, that there are to be found noble examples of integrity and self-sacrifice in the medical profession; but, on the other hand, it is to be feared that these are qualities which do not always commend themselves to local Trustees, or enhance the claims of candidates for their appointments. But whether this be the case or not, it cannot be said to be just to the inhabitants of a district that their sanitary condition should be dependent on the very slender chance of these qualities operating *pro bono publico* in any individual. We require not only that such positions should be given to men whose character and attainments are above suspicion, but that either some system of better checking from the Central Authority be devised, or that these positions be held for shorter periods, to prevent the development of that spirit of autocracy and local wire-pulling which become here, as in other departments of social organisation, the destruction of progress and philanthropic exertion. The present system seems to hang too much on a single thread. The matter of public health is of too great moment to be so treated; and those ratepayers who desire improvement deserve consideration equally with the mere cheese-paring economists, whose fancied frugality proves too often the greatest extravagance. That economy is required in those who manage public concerns is unquestionable; but the true, intelligent economy, which alone deserves the name, is rather the management of force and the wise application of it, than the reduction of appliances and the mere negation of expenditure.

This is a question for ratepayers to consider. Let them not forget that what is worth doing is worth doing well. Both the people and the press are bound to do their part in arousing and encouraging those to whom management of sanitary matters has been committed. The work is one which eminently demands united action; and it is certain that sluggishness and apathy are the blameworthy causes of untold disease, vice, and moral degradation. Contrasted with the work of these subtle yet potent factors of social misery, the ruin effected on the battle-field sinks into complete insignificance.

It would be an extravagant allowance to take an average of 5000 men per annum as the slaughter of Englishmen in battle; but, according to Dr. Maclagan,* 20,000 is about the number yearly sacrificed to typhoid. In spite of popular lectures on chemistry few persons are fully aware of the effect that free oxygenation has on the human frame. And if any true idea of the necessity of pure air to health could be insensed into the millions of our people, prodigious indeed would be the reduction of the annual bills of mortality.

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* See article in Nineteenth Century, November, 1879—"Is Typhoid Feve Contagious?"

IV. MEMORANDA OF FLOOD AND STORM IN THE YEAR 1883.

By A. H. Swinton.

THE outcry and grumble concerning our damp soggy winter and harvest prospects had hardly subsided when some interested parties at the sea-side got up an excitement by the prediction of a high tide. Many doubtless imagined men of Science had made some new discovery, and took tickets to Ramsgate or Jersey, places they would not otherwise have visited, in order to verify the important revelation. It is doubtful, however, if a greater amount of learning than any harbour-master has at his finger's ends was ever expended on the matter. Ages have passed since Seneca noticed that the flux and reflux in the tideless Mediterranean is greatest at the equinoctial; and only a year or two ago we were assured that at the time of the Equinox, and in stormy winter seasons, there is a much greater rise and fall in the water of our own Humber than would otherwise occur. It is consequently, then, not essential to puzzle over a malevolent conjunction of the Moon and Saturn in order to predict a high tide; nor is it essential to have deep insight into lunar and solar semi-diurnals and diurnals, and the excentricity of the orbits causing inequalities as the discord of harmonic notes. Indeed nothing now-a-days further than Whitaker's Almanack is essential to make a man a prophet of the long-shore tides. In that useful compendium we glean that the direction of strong winds, as well as the varying pressure of the atmosphere, considerably affects both the times and the heights of high water. As every sun-burnt yachtsman who has luffed and gyved for the purse of guineas knows, in the North Sea a strong nor'-nor'-wester, and a low barometer, raises the surface 2 or 3 feet, and causes the tide to set all along the coast from the Pentland Frith to London half an hour longer than is usual; while south-easterly and south-westerly winds produce opposite effects, which are felt as far down Channel as Dungeness. Again, in the Chops of the Channel, at Plymouth, and as far up as Portland, a sou'-wester with a low barometer raises the surface of the water, and north-easterly winds and a high barometer always lower it.

Now last March it so came about that the new moon fell on the afternoon of the 7th; and this auspicious event, on the same authority, would produce high tides between the 9th and 14th of the month. That these equinoctial tides would be extraordinary anyone might have assumed when a storm-warning arrived from New York, to the effect that "A disturbance likely to develop dangerous energy is crossing north of latitude 40°, and will arrive on the North British and Norwegian coasts between the 3rd and 5th proximo, attended by south veering to west gales"; with the supplementary remark, "Another follows two days after, and will affect Norway. Atlantic very stormy." At the time the barometer was already on the drop, and from the 5th until the 12th the mercury subsided; and then the aërial whirlpool was spinning eastward of the North Sea, and northerly winds blew strong on the eastern coasts of our island, accompanied with driving snow, rain, and sleet. Beneath the suction of moon, wind, and atmospheric vacuum, the tide began to mount like water in a pump. From the Pentland Frith to the Thames it rose, rolling in like a Noachian deluge. At the time of high water at London Bridge the tide had risen more than 2½ feet beyond the Trinity stone; and it ran up, spectators say, with great force for another twenty minutes, when it stood 3 feet above Trinity level and swamped the Surrey pier. At Dover the water surged to within a few inches of the top of the quays, and only the chopping of the wind to the north-west saved the town an inundation. The tide in the River Tees was one of the highest within recollection, and at Hull the salt spray drenched a fashionable congregation in St. Mary's Church and floated a low-lying district. The prodigies of the remarkable tide were supplemented in the newspapers by an account of a tidal wave in the Channel, one calm night, that might shame the bore of the Hooghly or Severn; but I am afraid the adventure that befell the *Aquila* steampacket, bound for Jersey, on that memorable occasion, must be consigned to the limbo of the great sea-serpent seen at Oban and the phantom ship of the Lagoons. Nor does it seem probable that this could have been an earthquake wave, or that any earthquake occurred about the 30th of March.

There appears no reason why the statistics of tide-guages should not appertain to the department of Solar Physics as much as the statistics of river-metres do; but I do not know any authority on the subject. Gewitter and *Zündende Blitze*, however, distinctly fall into Dr. Hahn's prolegomena, and storms and terrible lightnings we have of late experienced with a vengeance. Indeed the transit from June to July has been as wholly made over to the suzerainty of summer lightnings as the identical Romeo and Juliet period in 1878 was. Immersed in the exhaustive sultriness of an Italian solstice, our eyes have grown blear in watching the fantastic shapes of the mountainous clouds ever looming like ghouls of destruction on the horizon, menacing us from every quarter, and stretching out unawares their leaden wings over the expanse of summer blue. Incessantly a lurid light with hideous glare has vexed the repose and sparkle of the landscape. Electricians say that there is most free electricity in the air about sunrise and sundown, and least at noon; but we have experienced a day discharge and a night discharge, and the nerves of our ears are in unison with the patter of hail and the roar of the mill-race down the gutter. Several churches have been damaged by lightning, one being St. Botolph's at Cambridge, and many individuals have perished through an imprudence in sheltering beneath trees; houses in certain streets have been fired, leaving us to accuse the telegraph-wires, or quite as likely bad ventilation, judging from the propensity Old Nick has for coming down the chimney; and in one case the rifle of a sentry on duty has proved a fatal conductor of the electric fluid. Barns and stores have been fired, and a holocaust of cattle destroyed. Had no worse calamities befallen us as a nation, the tale of disaster would be dire even divested of the imaginary.

On the afternoon of June 21st, when the thermometer stood at no great height, a thunderstorm passed over Guildford. On the 24th a slight earthquake was experienced in Cornwall—a more serious affair than a slight trembling I felt at Maida Hill a few years ago, as would appear. During the night of the same day Cambridgeshire—a name suggestive of vaporous exhalations—became the centre of electrical disturbance; and the next day the lightning passed in the wind's eye, and played freely along a line drawn across England from the Thames to the Dee. The next day Cambridgeshire was still the centre of electrical disturbance, which moved southwards, the wind being west. From June 28th until July 4th the thermometer rose high in London, reaching as much as 84 degrees in the shade, and on Friday, June 29th, the heat at Aldershot was so excessive that the manœuvres had to be postponed. About midnight there were thunderstorms in the south-eastern counties. On Saturday evening the electrical disturbance was pavilioned near the Wash in Lincolnshire and Norfolk, while the south-east was bathed in a prolonged and peaceful twilight. On Sunday, July 1st, the thunderstorms danced away to the east of Scotland and the vicinity of the Forth. On Monday evening the electrical disturbance had shifted to Jersey, and some wished it fairly on the road to Spain. But as I looked from my window, towards midnight, there it was back like a Will-o'-the-wisp, bilious, growling, and flashing. The wind was reported to have been from the south-west at the time, but the electrical discharge ran right up the centre of England from Hampshire to Yorkshire. The next day the disturbance centred in Yorkshire and spread to France, and about this time to Switzerland, destroying man and cattle in the pastures. Then the temperature at York reached 70 degrees. About midnight it is related that there was a thunderstorm at Chatham, where a policeman was killed; but on Wednesday afternoon the chief disturbance was on the north-west coast at Ardrossan, whence it ran south to Chester.

In a late communication I drew attention to the waves of heat and cold that make up what is termed climate, and I believe it may be shown by statistics that a great heat-wave has just passed over our heads, travelling from west to east, of which heat-wave the earthquake was the herald. The lightnings and thunders in this sense might be compared to the discharge of a thermo-electric machine, the flashes moving to the point where the air temperature stood highest, as appears in many cases. The path of the discharges that branded our island with the sign of the cross, from east to west and south to north, further substantiates this view; and it may be observed that the whole disturbed area is pretty well included by the July isotherm of 59 degrees, in which we may consider London, Cambridge, York, &c., as so many warm centres, the carbons of the recent discharges.

It appears to be pretty generally admitted that Auroræ Boreales and magnetic storms arise from the sun-spots when they are of unusual magnitude and centred upon our globe; but can sun-spots originate a heat-wave with thunderstorms? To comprehend this question, while the recent electrical commotions were in progress, I one evening turned a field telescope upon the sun when on the point of setting, and there plain enough were the spots near the centre of the disk,—one large and triangular, with a distinctly distinguishable umbra: someone, I understand, has calculated that they have been occupying 50,000 square miles of the sun's surface. If, therefore, spectroscopists do not allow the nucleus of the sun to be black hot, peradventure it has been reflecting the heat of its photosphere like a cannon-ball through its rags and tatters.

The rose, it is said, was disclosed from the brain of the thunder god, so flood and storm may leave a trace of the beautiful behind. Since I first saw the banks of the Wey the golden day-star has run from a period of few spots to a period of many spots, and Nature has run through a cycle of change. In 1875 grasshoppers sang merrily over the grassy slopes in the autumn; lately it would be hard to find them nearer than Box Hill, where, last year and this, they have been in some plenty. The painted lady butterfly was common here for a series of years; the last two years there have been none to be seen, and now this spring a few have come back. The clouded yellow butterfly, of which only one example came under my notice in 1875 and 1881, was great game for schoolboys in 1877; and in 1881 the whole country was a-flame with common yellow underwing moths. The last two years the silver writing of slug and snail has covered leaf and garden-seat. I remember a similar visitation in the Highlands during the wet in the early portion of the summer of 1868. This year the bookworm has taken the place of cricket and cockroach, and multiplied in the chinks of our kitchen hearth,—an evil prognostication for literature,—and I have noticed the cow parsnip in the hedgerow in luxuriant, and I think unusual, blossom.

V. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 551.)

In this article we shall place before our readers the number of Science Schools, the number of pupils attending these schools, their successes, and the cost to the country of the science instruction carried out under the Department of Science and Art in these Institutions. I think the facts that will presently be stated on these branches of the subject, taken in conjunction with those stated in previous articles, will be sufficient to convince all independent thinkers on the subject of Scientific and Technical education that the system is most inefficient and costly. A scheme less costly and more efficient will be proposed in the next article, prefaced by showing what could be accomplished even in evening Science Schools, by stating what has actually been accomplished in evening Science Classes.

In the last article it was pointed out that the Department held Science Examinations in two different classes of educational institutions, *viz.*, Training Colleges and the so-called Science Schools. The number of Training Colleges in England, Wales, and Scotland, in which the Department held Science Examinations in December, 1881, amounted to 37, distributed as follows:—

England and Wales.	
For Masters only	17
For Mistresses only	15
For both Masters and Mistresses	1
Scotland.	
For both Masters and Mistresses	4
Total	37

It is not recorded in their Report, as far as I can make out, the number of individuals under instruction in these colleges; all that is given in the Report are the number of classes examined (which amounted in December, 1881, to 105) and the number of successful individuals (these numbered 1521); with a larger number of classes than in the previous year a fewer number were successful, and in all the subjects examined upon the successes were the most numerous in the lowest stage, and in the second (the lowest) class in that stage; in Elementary Botany, for example, 30 passed in the first class, 297 in the second class, and 170 failed; and the opinions of the Department's own Examiners on the Science teaching given in these Colleges were quoted in the last article (p. 542).

For this worse than doubtful Science teaching there was paid to the teachers in the English and Welsh Colleges £3308 3*s*. 4*d*., and to those in the Scotch Colleges £403 3*s*. 4*d*., making a total of £3711 6*s*. 8*d*.

Before proceeding with the investigation into the so-called Science Schools, we will give a quotation from the twenty-ninth Report respecting them, which will show the *ricketty* foundation on which, according to the opinion of the Department itself, very nearly two-thirds of these schools are based, although a most expensive administrative machinery for governing and directing these ephemeral institutions has been permanently established on a very substantial money basis. It is stated in the Report "that the term 'Science School' is employed in this Report in a somewhat wide sense, each separate institution in which *one branch* of Science, or more than one, is taught, in connection with the Department of Science and Art, being counted as a School." Examinations were conducted in the sessional year 1880-81 in 1360 of these Science Schools; of these 1000 were in England and Wales, 151 in Scotland, and 209 in Ireland; and, according to the Report, out of this number there are about 260 of these of a more or less *ephemeral* character," and there are about 580 of them "which *depend* more on the teacher or the teachers, *through whose energy* they came into operation, than on any very *permanent local organisation*. They are superintended by Committees, but they are generally held in rooms hired for the purpose, and *though they have been in operation for some years*, and it is *probable* that they will be continued, *the death or removal of the teacher might, and in many cases would, lead to their being closed*."

The number of individuals under instruction amounted to 61,177: whether in this number are included those under instruction in the Training Colleges does not appear to be stated in the Report. Before stating the number who came up for examination, it is desirable to impress again upon the reader that the teacher is only paid for instructing those who *pass;* he is not paid by the STATE anything whatever for those who do not come up for examination, or for those who do not pass, and therefore I think everyone will agree with me that the Department has no right—as we shall see further on they do—to take *credit for those they do not pay the teacher for instructing;* they do this apparently for the sake of making the expenditure appear less than it really is, by counting those they do not pay the teacher for instructing as well as those they do pay for.

The number who came up for examination amounted to 38,837; in addition 5804 self-taught students, and pupils in classes *not entitled to claim payment on results*, presented themselves for examination: out of the total 44,641 individuals who presented themselves, 30,518 passed. The Report gives no information, as far as I can discover, as to how many of the 5804 passed on whom payment on results could not be claimed.

We have arrived, then, at the number of individuals under instruction, the number who came up for examination, and the number who passed; and now what we would desire to know is *how they passed*, but on this essential point for testing the efficiency and benefits of the instruction the Report fails in giving the necessary information; it is vague and mysterious on this most important point. We are told, in the table on page 55 of the Report, that "the number who came up in the Elementary Stage alone amounted to 57,614, and yet we had been previously informed that only 44,641 presented themselves in all the different stages. We have to go back to page 53 of the Report to find out what the Department *means* by the number who came up; it means "the total number of papers worked." It was new to me to learn, as I think it will be to all my readers, that a *paper* can can come up for examination, and can pass or fail. As there are twenty-four subjects examined upon, and as a student may, and very frequently does, go in for more than one subject, the number of papers worked gives no information as to the number of students who came up in the different stages, and their successes; however, I can only give it as I find it in the Report: the reader has consequently to remember that the expression "the number who came up" in the different stages means the number of papers worked, and not the number of individual students;—

Number who came up in the *Elementary Stage*	57,614
,, of First-class Successes	10,976
,, of Second-class Successes	27,799
,, of Failures...	18,839
Number who came up in the *Advanced Stage*	13,344
,, of First-class Successes	2,200
,, of Second-class Successes	7,137
,, of Failures...	4,007
Number who came up in *Honours*	1,342
,, of First-class Successes	91
,, of Second-class Successes	395
,, of Failures...	856

This table reveals to some extent the state of Science teaching in the United Kingdom, under the Department of Science and Art, in the sessional year 1880-81, and it presents no flattering picture of the value of the teaching given in these Science Schools; and this is due mainly, if not entirely, to the system of teaching that has to be pursued, and the *miserable pittance*, as will be shown presently, many of the teachers receive for their labours. Sixty-three per cent only came up for examination, and deducting 4000 from the 30,518 as representing the number who passed out of the 5804 self-taught students, &c., only 43·34 per cent passed, and the majority passed in the elementary stage, and chiefly in the second or lowest class. Only 91 successful papers were worked in the first class in the Honours; and if we take the successful students in this class as working on an average two papers each, we find that out of the whole number of students only 45 passed in the first class in the highest stage, and probably these successful ones chiefly belonged to the class of self-taught students, &c., on whom no payment was made. It may be replied that only a very small number of the students at the different Colleges at Cambridge, Oxford, Dublin, &c., succeed in passing the examinations for the highest prizes, but there is no parallel between the two cases; the students at the Colleges ascertain, by reason of their intermixing together, who are most likely to be successful in these examinations; this knowledge operates, therefore, in limiting the number who compete; but there is no intermixture of the students in the 1360 Science Schools: furthermore, these schools are scattered over the United Kingdom, while the colleges are restricted to a small area of the country.

Before passing to the question of payment, we will give the number who come up for examination in Chemistry ; as in the individual subjects the number must, I think, represent those who came up, passed, or failed, as well as the number of papers worked. The number who came up in Inorganic Chemistry (Theoretical) amounted to 5299 for the Elementary Stage and 938 for the Advanced Stage ; or for every 100 who presented themselves for examination in the Elementary Stage, 17·7 presented themselves in the Advanced Stage. No entry appears in the Report for the Honours Stage ; indeed the Honours Examination for all the twenty-four subjects examined upon appears, as far as the Science Schools are concerned, to be more for ornament than for use. The following are the numbers who passed and failed in the different branches of Chemistry (Theoretical and Practical) :—

Elementary Stage, Inorganic Chemistry (Theoretical).

		Percentage Numbers.
Number of First-class Successes...	1226	23·13
,, of Second-class Successes	2604	49·14
,, of Failures	1469	27·72

Advanced Stage.

Number of First-class Successes...	115	12·26
,, of Second-class Successes	523	55·75
,, of Failures	300	31·98

Inorganic Chemistry (Practical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	682	39·95
,, of Second-class Successes	774	45·34
,, of Failures	251	14·70

Advanced Stage.

Number of First-class Successes...	208	29·17
,, of Second-class Successes	263	36·88
,, of Failures	242	33·94

Organic Chemistry (Theoretical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	55	31·42
,, of Second-class Successes	71	40·57
,, of Failures	49	28·00

Advanced Stage.

Number of First-class Successes...	22	29·33
,, of Second-class Successes	37	49·33
,, of Failures	16	21·33

Organic Chemistry (Practical), Elementary Stage.

		Percentage Numbers.
Number of First-class Successes...	22	26·50
,, of Second-class Successes	38	45·78
,, of Failures	23	27·71

Advanced Stage.

Number of First-class Successes...	54	54·00
,, of Second-class Successes	29	29·00
,, of Failures	17	17·00

In perusing these figures we notice that whilst 5299 went in for examination in the Elementary and 938 in the Advanced Stage in Inorganic Chemistry, only 175 went in for examination in the Elementary and 75 in the Advanced Stage in Organic Chemistry : this appears but a small return from the 1360 schools, or the 61,177 pupils in these schools, supplemented as this number was by 5804 pupils from extraneous sources.

We are deprived of the means of forming any opinion on the practical examinations in the Advanced Stage, both in Inorganic and Organic Chemistry, for, unlike the examinations given in every other subject, even in every other examination in Chemistry, including the Elementary Practical in both divisions of the Science, the examination given is not stated ; all that the public are informed about these examinations is, that a certain number of substances may or may not be present in the mixtures given for analysis ; we are not informed how many and what substances were present. No good and sufficient reason can be assigned for withholding this information from the public ; for if the substances given were stated it would not assist the teacher in cramming up his pupils for these analytical examinations in the future,—yet this information is withheld, whilst the questions given in the theoretical examinations are printed, which information materially assists the teacher in cramming up his pupils for these examinations hereafter, especially as there is always the same set of examiners.

I believe, from the experience I have had in this class of examinations, that if 75 per cent of the substances that it is stated may be contained in the *mixtures* were present, and the students had to examine for all the substances named, not many of them would be able to complete the analytical examination with tolerable accuracy *in the time allowed*, viz., four hours; and their difficulties would be further increased if they were unfamiliar with the laboratory they were examined in, as must frequently be the case, and especially as no competent person may be present to direct them.

What are termed the elementary practical examinations in Chemistry I regard as no more practical than what are termed the theoretical examinations, as they are merely written examinations like the latter; indeed the Department does not appear to attach much importance to them, as they give the teacher 10*s.* less for a first class in these elementary examinations than for a first class in the elementary theoretical division, although, according to the Deparment's rules, each lesson in the practical course must last at least an hour and a half, whilst in the elementary theoretical it need only last one hour.

We have now arrived at that stage of the investigation when we must examine into the cost of these Science Schools. In the financial year 1880-81 the payment on results to the teachers in the 1000 schools in England and Wales amounted to £32,723 4*s.* 4*d.*; the teachers in the 151 schools in Scotland were paid £5803 7*s.* 5*d.*, and those in the 209 schools in Ireland £4992 11*s.*; making a total of £43,519 2*s.* 9*d.*: there was therefore paid to the Science teachers in the Training Colleges and Schools in that year £47,230 9*s.* 5*d.*

The £43,519 2*s.* 9*d.* had to be distributed amongst 1762 teachers: the average payment per teacher was therefore £24 13*s.* 11*d.*,—not a large sum when we consider what the country expects them to accomplish; but in probing a little deeper into these statistics we arrive at results which will astonish most people. It will be found, on examination, that in more than one-third—*viz.*, 369—of the schools in

England and Wales the payments of the teachers varied from £1 to £10, and in 21 of the schools the former sum only was obtained; in 66 out of the 209 schools in Ireland the teachers' payment varied from £1 to £10; and in 46 out of the 151 schools in Scotland the teachers' payment varied from £2 to £10. It will be observed that the payment to the Science teachers in Scotland never descended to the munificent sum of £1. When the payment exceeded £1, but did not exceed £10, the miserable pittance had to be shared not unfrequently by two or more teachers; I noticed in one case that *four* teachers had to share £7 between them. Let us notice next the *time* a teacher must give, even *to have a chance* of obtaining a result payment of £1; he must, even to have a chance of gaining that small sum, give—at least so states the "Science Directory"—28 lessons, and each lesson must last at least one hour for the theoretical courses and one hour and a half for the practical courses. "It is not meant"—so states the "Directory"—"*in any way to suggest that that amount of instruction is sufficient*, or *to guarantee* the teacher's RECEIVING PAYMENT if that amount of instruction *alone* be given"—a pretty plain hint that more than 28 lessons are necessary for even a chance of success, although it would appear that it was not considered, by the very well paid permanent officials, politic to state in exact words the time they thought necessary to be given, as it might have the effect of deterring many from becoming teachers under the system; and it might also have the effect of drawing greater public attention to the vast difference between the *precarious* sums the teachers earn and the *secure permanent* salaries the officials, who exist upon their labours, are paid.

In addition to the time that must be devoted to the teaching of the subject, the teacher of an Experimental Science will—if he illustrates at all, as he ought to do, his teaching by experiments—have to expend a not inconsiderable portion in their preparation: this will on an average amount to more than double the time he has to give to the actual teaching of the subject, and yet, after all the labour and time he may have bestowed, he is not sure under this system of any payment, however small, being awarded him; but even if he does happen to have awarded him the munificent sum of £1, we have learned from the letter of a Science teacher (p. 95) that he may not touch payment until thirteen months after he commenced his course of instruction.

Before proceeding further with the payment part of the question, let me ask our Statesmen who are responsible for the Education estimates our Senators who vote the money, and the tax-payers who pay it, what benefits they expect the nation will derive from this Science teaching? If they take as their authorities on the subject those who are pecuniarily interested in maintaining the present system unaltered, a long list of benefits to be derived will be set forth; but in passing allow me to remark it is still *expectation*, not *realisation;* the ORGANISING SCIENCE MASTER, for instance, narrates a long list in his autumnal peregrinations through the country: he has been for the last year or two expatiating largely on the benefits our greatest industry, Agriculture, *will* derive from the Science teachers' instructions in the Agricultural Districts. The Lords of the Privy Council have been recently promising requisionists that Hygiene shall be added to the subjects taught: the Lords may promise, but where are the performers? Is the costly Department of Science and Art, unaltered and unimproved, to be continued the agent in the future for improving and extending the teaching in Pure and Applied Science, and to be depended upon for making the scientific education in England equal to that of Germany, and other countries more advanced than our own, in that branch of instruction at the present time? The Department cannot claim to have accomplished this in the past or the present, for they are still sending out Commissions—in addition to other independent, or nominally independent, Commissions—to continental countries to learn how it is to be accomplished.

Numerous letters are at present appearing in one of the London newspapers on the question "What are we to do with our Boys? The question came to be discussed by reason of an advertisement appearing for a clerk at a salary of £30 a year. This salary is thought by the writers of the letters as far too small, even for a *commencement;* but, small as it is, it is equal to the earnings of many of the Science teachers, and it is superior to the average payment per teacher, and the situation is preferable to that of the Science teacher in most other respects—the salary is secure; the clerk knows the exact day he will be paid; he will not have to wait nearly a year before he has a chance of receiving his small stipend; he has not to spend any of his leisure hours in preparing himself by *study* for his daily work; he has not to expend any of his small salary in purchasing books to fit him for and keep him abreast of his daily labour; he has not to work from 10 a.m. till 10 p.m. to earn his salary:

and he has opportunities for promotion: we have already learned how it fares with the Science teacher in these respects.

It is necessary, in order properly to estimate whether this Science teaching will have any effect in improving the industries of the country if the present system remains unaltered, to realise more thoroughly than we have yet done the teacher's position as regards the payment the State may award him. Each course of instruction must consist at least of twenty-eight lessons, and each lesson must last at least one hour, and for practical subjects an hour and a half; and even for non-experimental subjects a teacher cannot properly teach them without some preparation for each lesson,—say one hour is or ought to be devoted to preparing matter for the lesson; if an experimental science two hours more for preparing the experimental illustrations: in the latter case, therefore, four hours are or ought to be expended on each lesson. Now if the teacher is awarded any sum at all, it may, we have seen, be the munificent sum of £1 for his labour: this would be at the rate of less than twopence farthing per hour. If he was so fortunate as to be awarded ten times that—*viz.*, £10—it would amount to 1*s.* 9¼*d.* per hour.

The teacher cannot of course live on these small sums, and therefore, if Science teaching is his *sole* occupation, he must, in order to make a living, teach one or two subjects in half-a-dozen or more schools, or he must teach half-a-dozen or more Science subjects, knowing little or nothing about the majority of them (see pages 96 and 97), in one or two schools, and he must cram his pupils for the stage and class which offer him the largest chance of success, and this we learn from the numbers quoted in the Science Report is the lowest stage and the lowest class in that stage. And as long as this state of things continues what the Deparment's Examiners complain of—*viz.*, the conventional descriptions of pieces of apparatus which have never been seen, still less used; book-drill, in place of intelligent oral teaching; loading the memory with statements, with the sole object of reproducing them on paper at the Examinations, without at all understanding, or even attempting to understand, the Science to which these statements belong—must continue to be the mode of teaching under the system, because experience has taught the teachers that it is the one best adapted for passing the largest numbers, and, in addition, it is the only one they could possibly adopt when they have to be so continuously employed in teaching, and unfortunately it is a system that places the incompetent and the competent educator on the same level.

Such teaching can never benefit the industrial world; it is more likely to have the contrary effect, for a little knowledge of the Inductive Sciences is a dangerous thing, if the possessor of the ill-acquired and unsound information of any one of them attempts to apply his so-called scientific knowledge to the improvement of any industry. I have given examples of this in my work "Education, Scientific and Technical; or how the Inductive Sciences are Taught and how they ought to be Taught," and I could, out of my own experience, add many more.

I must press yet another question on those of our Senators, whether they be landlords or manufacturers, who have to employ high-class labour, whether that labour be brainwork or handwork, if they can obtain it on the following terms: the payment to be so far uncertain that the labourer is to have no say as to what is awarded him; but even after some payment has been awarded him by one set of his employers' employees, another set of his employees can reduce the payment awarded by the former set, or even not allow any payment at all; yet these are the conditions the well-paid permanent officials at South Kensington impose on the Science teachers, and our Senators sanction it by voting the public money on these conditions, and yet they know by experience they are not able to obtain for themselves high-class labour on any such terms.

It may be replied that 1762 teachers have engaged on these terms; theanswer I make to that statement is this—that if these teachers, or any considerable number of them, are able on these terms so to teach their pupils, they become by reason of that instruction the improvers of the industries of the country, the sooner our Members of Parliament urge the Government to pay all the permanent officials, from the highest to the lowest, at South Kensington, in the same way the better, for then we should—according to these officials' doctrine—obtain the best labour at the cheapest rate.

It may also be urged, in reply, that the teachers are not altogether dependent on the payment on results, as fees are paid by some at least of the pupils: even if these fees are real in all cases—which I believe is not always the case—the total for the United Kingdom amounted in the year 1880-81 to £12,120 17*s*. 6*d*.: this divided amongst the total number, 1762, would amount to nearly £7 for each teacher. The tax-payer may pay for instructing young] men in Science at the Normal Science School at South Kensington, but it will be found in the long run that the most talented of them, after they have obtained the instruction, will not engage themselves as teachers on these terms, for they see not only the uncertainty which prevails as regards what may be awarded them for their labour, but they see also that their employment may be taken from them by an irresponsible official by the mere stroke of his pen, and the examples which show them the treatment they may be subjected to do not pass by them unheeded.

In each Annual Report of the Department the cost per head is stated, and, as I consider that the statement as given is most misleading, we will, in concluding the present article, briefly investigate it. It is stated in the 29th Report that "the average payment for each individual student under instruction was 14*s.* 2*d.*" for the sessional year 1880-81; this 14*s.* 2*d.* per head is arrived at by distributing the sum paid for results, *viz.*, £43,519 2*s.* 9*d.*, on the 61,177 pupils, and not on the number (about 26,000) which the teachers succeeded in passing, and which they were paid £43,519 2*s.* 9*d.* for passing. But if it was calculated on the number passed, does that represent the whole cost to the country? Has not the cost of the administrative machinery at South Kensington, the interest on the sum expended on the buildings, and the cost of the stationery and printing also to be taken into account? I think so, and I think all accountants would agree with me. With regard to the printing and stationery alone, Mr. Matthew Arnold, one of the chief inspectors in the Education Department, draws attention to the extravagance on these items in the Department of Science and Art.

(To be continued.)

VI. THE BRITISH MANIA.

By J. W. SLATER.

IT must not be supposed from this title that I am about to sit in judgment on the feeling which was once applauded as patriotism, but which is now sneered at by "advanced" speakers under a short and intensely vulgar name. My subject is the propensity, common among British naturalists, or rather I might say collectors, to confine their operations to the fauna, or the flora, of the United Kingdom, and to pass over those of the rest of the world with sublime indifference. Such persons, if, *e.g.*, engaged with the "study" of Lepidoptera, make it their life-object to get together a "complete collection"; that is, to accumulate British specimens of all the species of Lepidoptera known to inhabit the British Islands. In the pursuit of this task they are often so regardless of trouble and expense that sums of £5 and upwards are sometimes given for an insignificant moth, which, when acquired, proves nothing. At the same time a Continental specimen of the very same insect is often thought not worth accepting as a gift.

This propensity is, I believe, absolutely peculiar to Britain. I have known German entomologists, who, whilst rigorously careful concerning the locality of every specimen in their collections, and to note any local peculiarities which may occur, yet attach no especial value to any insect from the mere fact of its having been caught within the boundaries of the German empire. A Dutch, French, Swiss, Hungarian, or Danish specimen has for them the very same worth. Our true British maniac, on the other hand, often cares very little about the exact locality of his acquisitions. If they are only British,—on which point he is often deceived,—it is for him enough. But of this hereafter.

I will now ask, What constitutes a British species? A definite answer, based on a logical principle, is not to be found. It will not do to say anything captured within the four seas of Britain. All species or specimens of species found in Belgium or France are at once excluded. But a species or a specimen met with in Ireland, in the Outer Hebrides, or the Shetlands, is admissible. Twenty miles of sea form a boundary to the "British" district in one direction, but not in another. What is caught beyond the straits of Dover is foreign; what is caught beyond St. George's Channel or the Pentland Frith is still "British." Hence the boundary might seem to be purely political, and the question might arise whether, in case of the secession of Ireland from the United Kingdom, its fauna would no longer be regarded as "British"?

But even this idea of a political boundary fails us. The Channel Islands, though politically British, are to naturalists of the class above mentioned, strictly foreign. Hence I feel free to maintain that the district to which our friends confine their attention is neither natural nor political, but a jumble of both.

But leaving this question to be dealt with by the British maniac at his leisure, it must be remembered that Britain is zoologically merely a much impoverished outlying district of the Palæarctic region and European sub-region, following the arrangement of Mr. A. R. Wallace. Its fauna differs from that of western and central Europe mainly by deficiency. France, Belgium, Germany, possess many species which we have not; we, on the contrary, can claim but very few species which are not found in them. Peculiar genera or families are out of the question. If, on the contrary, England had been separated from the mainland of Europe by a deep and ancient sea, as is Madagascar from Africa, and if its animal forms had been varied accordingly, the British fauna would then have been a worthy subject of the most minute study. Or if Britain had held an intermediate position between two great regions, or even sub-regions, in which their respective faunæ met and interpenetrated each other, the interest would have been still more profound. But the fauna of England depends merely (*a*) on the number of species which have survived the glacial epoch; (*b*) on the number of those which, on the cessation of that fearful calamity, had time to find their way over before the "silver streak" was interposed between Britain and the Continent; and (*c*) on the number which have, since that date, escaped destruction by man's interference. Hence the most faithful study of the present British fauna will throw remarkably little light on the principles of animal distribution.

Another objection to the British mania is that the work, whatever value it may possess, is overdone. Scores of collectors are all aiming at one and the same object, and attaining, more or less completely, the very same results, doing essentially over and over again what their forerunners had already accomplished.

A further misfortune is that the study of the entomology of comparatively unexplored countries is thus seriously hindered. A traveller, let us suppose, has formed extensive collections in some such country, and in order partially to defray his expenses, he offers his duplicates for sale. Save for a few large and showy forms he finds that there is no *market.* Everywhere he hears the cuckoo cry, "I only collect British."

I will now glance at some of the excuses offered by the British maniacs for their singularity. The first is that a man may hope to get a "complete" collection of British species, but that if he extends his operations to the whole world, the task will be beyond his time, his space, and his resources. I should think, on the contrary, that the very finite character of an exclusively British collection, not an advantage, but a defect. At the same time, admitting that a general collection, even of a single "order" of insects, is beyond the scope of most private individuals, I submit that there are other modes of limiting our attention, which would be more interesting and more useful to science. The collector might limit himself to some particular family as occurring over the known world. Or, taking up the subject from a zoogeographical point of view, he might confine himself to some region or sub-region. A collection of the world's Carabidæ, Chrysomelidæ, Sphingidæ, Coreidæ, &c.; or, again, one of the Lepidoptera of the Mediterranean basin, or of the Neuroptera of the Antillean sub-region, would be far more instructive than the everlasting British displays that meet our disappointed gaze. But do such collections, complete or otherwise, exist?

Another very common plea is that of convenience. It is easier, we are told, to form a British than a foreign collection. This is, at the present day, very doubtful. The collector who wishes to capture his specimens personally, will find an entomological tour in many parts of the Continent easier and cheaper than, say, a visit to the Shetland Islands, the Hebrides, the west of Ireland, &c. Abroad, too, he will be less inconvenienced by the trespass laws, which, in all ordinary circumstances, do not extend to waste lands, heaths, deserts, &c., as they do in this our highly-favoured country.

If he wishes to form his collection by purchase, he will find foreign specimens cheaper than British, and more frequently genuine. It is a fact that so-called British specimens of insects, birds, eggs, &c., are very frequently obtained from abroad, even from Siberia or Western Asia. Now, as many species vary locally, serious errors are thus introduced. A bird's egg is sold to a collector as "British." True, the species of bird occurs more or less frequently in Britain, but the egg in question was laid in Norway!

Again, it may be asked, especially in case of strong-flying birds and insects, When have we right to call them British? A solitary specimen straying hither, or even driven over by a tempest, from the Continent or from America, has very doubtful right to be so classed. Even if such occasional stragglers remain and breed with us for a season or two, we cannot consider them as true natives. But, according to the prevailing code, every such visitor is British, and is accordingly shot down, or otherwise captured. This, though the last, is certainly not the least, objection to the British mania. Not merely all such occasional wanderers, but many unquestionably native species, are in a fair way for extirpation, owing to the high price set upon their heads. One of the most efficient means to ensure their preservation would be the abandonment by our collecting naturalists of the British mania, with all its narrowness, its pettiness, and its gullibility.

Finally, I may point it out as curious that, with all this apparent desire for a thorough knowledge of the fauna of our own country, and with such numbers of collectors, all the orders of insects but two are practically neglected.

ANALYSES OF BOOKS.

*Darwin considered as regards the Causes of his Success and the Importance of his Works.** By M. Alph. De Candolle. Geneva: H. Georg, University Publisher.

In this little work the distinguished author gives a vivid and truthful survey of the condition of the organic sciences shortly before the time when the "Origin of Species" made its appearance. Naturalists had become profoundly dissatisfied with the labour of describing and distinguishing species. They were driven to admit that the limits of species became the more vague and fluctuating the more closely examined. The alleged physiological criterion, the power of mutual reproduction, broke down. Thus M. Naudin showed that two species of *Luffa*, clearly distinct morphologically, were yet capable of mutual fecundation. Palæontological discoveries showed a successive diversity of beings which could not be accounted for by Cuvier's theatrical hypothesis of sudden, successive creations and extirpations. The author, four years before the appearance of Darwin's great work, showed ("Géographie Botanique Raisonnée") the appearance, in certain cases, of new forms derived from former ones, and proved further that species had passed through and survived geological and climatic changes. At the same time the astronomical notion of unlimited time, the embryological researches of Baer, and the more intelligent study of monstrosities, all combined to shake the unsatisfactory fabric of the Old Natural History. The hour therefore had come, when the man appeared. Half a century earlier Darwin—like Lamarck, Oken, Goethe, Wells, or his own grandfather Erasmus —would have found the world not prepared for his revelations.

We cannot omit here to notice a brief digression. M. De Candolle calls attention to a forgotten writer, A. M. Duchesne, who, in a "Natural History of the Strawberry," published twenty-four years before Goethe's "Metamorphosis of Plants," and thirty-five years before the earliest of Lamarck's works, announced that "the genealogical order is the only one which Nature indicates, the only one which fully satisfies the mind; every other classification is arbitrary and void of ideas." He even proceeded to draw up a genealogical tree of the strawberry, much as is now done for animal groups by Prof. Haeckel and others. Yet Duchesne, in this respect, was so completely ignored that M. Silvestre, his conscientious biographer, in delivering his *éloge* before the Royal Society of Agriculture, entirely overlooks this point.

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* Darwin consideré au point de vue des Causes de son Succés et de l'Importance de ses Travaux.

But M. De Candolle, whilst fully recognising that the time for a grand re-organisation was come, admits also that for the task Darwin was needed. He doubts whether even Mr. A. R. Wallace, the co-discoverer of the hypothesis of "Natural Selection," could in the absence of Darwin have secured its acceptance. He considers that among naturalists Darwin alone had the exceptional power of concerning himself with the most trivial facts and with the loftiest generalisations.

M. De Candolle notices Darwin's peculiar conduct towards his adversaries. He evidently had no love for polemics. Instead of answering he pursued his way. In particular he never attacked religion, and his results are now more and more widely accepted by Divines as hostile neither to Theism nor to Christianity.

In conclusion the author describes a visit which he paid Darwin in the autumn of 1880, on which occasion he found the veteran naturalist "more animated and apparently happier" than at their last interview, forty-one years previously. This fact may seem trifling. We commend it to the notice of the author of that strange pamphlet "All the Articles of the Darwinian Faith."

In a note M. De Candolle pronounces the term "transformism" preferable to "evolution," since the successive changes of forms are not always in the direction of a higher development. The word transformism may comprehend all the modifications of forms in whatever direction they may proceed.

On the subject of degeneration he remarks that "Mr. Ray Lankester published in 1880 a small volume entitled 'Degeneration, a Chapter in Darwinism,' without suspecting that degenerations and abortations were among the principal subjects of the elementary theory of Botany, by De Candolle." He refers to the edition of 1819, page 105.

The present work may be pronounced an accurate and luminous epitome of the history of the Darwinian movement in natural history.

The Creed of a Modern Agnostic. By Richard Bithell, B.Sc., Ph.D. London: G. Routledge and Sons.

This book touches upon and occasionally enters into regions which lie beyond our legitimate cognizance. The author seeks to rectify certain current notions concerning Agnosticism. He tells us that it does not mean one who knows nothing, or who professes to know nothing. He refers, in a note, to Mr. Tennyson's poem "Despair," in which occurs the popular phrase "their know-all and know-nothing creeds," and remarks "It is scarcely possible that Mr. Tennyson can have been so imperfectly acquainted with the views of Agnostics as to suppose that they professed to *know nothing*." He tells the reader that "Agnosticism is a theological term, and is applied in a strictly limited and conventional sense to a class of thinkers and writers who believe that there are certain things connected with Religion and Philosophy which we not only *do not know*, but which we have no means of knowing, simply because we have no faculties by which we may get such knowledge." He draws a clear, and, we admit, a tenable, distinction between the Agnostic and the Atheist. He rejects the common insinuation that Agnosticism is "a refuge for the thoughtless and the mentally ignorant." He considers that the publication of the work before us has become a "pressing necessity." He claims no right to speak on behalf of others, and admits that Agnosticism has not been formulated as a definite creed. But he insists that in the sermons and theological works of the last forty years there "appears a reticence of speech, a modesty of assertion, and an absence of false assurance, which are eminently characteristic of the Agnostic spirit."

After these introductory explanations Dr. Bithell lays down a series of six propositions, which we quote, though we cannot enter into their formal discussion:—"Of transcendental truth, absolute truth, of pure being, of things in themselves, man knows nothing; nor does it appear that in the present stage of human development he has the mental faculties for acquiring such knowledge." "There is a large body of practical truth accessible to the human mind which we are capable of knowing as positively as we can know anything, *not absolutely*, but with a certainty beyond which we have no interest in knowing anything." "Between the domains covered by the known and the unknowable there is a vast unexplored region of unknown but knowable truth, which constitutes the proper and legitimate field of speculation and research." "There are many things which we *believe*, but which we do not *know*; and we believe those things either on account of the evidence by which they are supported, or because we have to some extent the means of verifying them." "The proper objects of human knowledge and belief are phenomena,—that is, the forms and modes in which the Unknowable manifests itself. These manifestations, as they affect the intellect, furnish the groundwork of Science; as they affect the emotions, the rudiments of Religion." Lastly, "Morality has its origin in human needs arising from the instinctive desire of individuals to form themselves into social groups; it is often enforced by sanctions embodied in religious creeds, but exists before and independent of them; it also becomes more imperious in its demands as societies become more highly organised."

In the development of these propositions the author expresses occasionally views which are open to discussion. We turn, *e.g.*, to his interesting attempt to explain the existence of evil. "Evil," he writes, "both physical and moral, is seen to indicate nothing more than the development of higher sensibilities and more acute powers of discrimination." In working out this supposition he tells us that "passing from the contemplation of vegetable to that of animal life an enormous increase in the complexity of the organisations is presented to our view, and a new phenomenon appears in the *evolution of physical evil or pain*." Now Dr. Bithell must be aware that there is no sudden enormous increase of complexity observed in passing from the vegetable to the animal world. There are animals simpler in their structure than are many plants, and that there are beings holding a doubtful position,—even some capable of being regarded as morphologically plants, but physiologically animals. Surely it is rash to say that all animals are sentient, and all plants unconscious, insentient.

In like manner the author, in accounting for moral evil, seems to us to make a far too absolute boundary between the lower animals and man. He writes:—"It does not appear that a sense of wrong, or the opposite principle of right, is felt by any other part of the animal world." Again, "All those acts which when done by human beings we call *sins*, crimes, and *misdemeanours*, are if done by the lower Mammalia regarded without moral disapproval; and the difference in our estimate of the acts in themselves, [incomplete?] but from the consciousness that we have faculties by means of which we discern the moral character of these acts. This we believe the brute creation cannot do."

Against all this we must put in a most decided protest. We have distinct evidence that amongst social animals there exist the rudiments of positive law. Offending ants, rooks, &c., have been observed to be punished not by the individual aggrieved, but by the community. Correction, and even death, is inflicted in cases where there has been transgression not against any individual, but against the supposed interests of the community. Now law presupposes a recognition of the difference between wrong and right, and is in its absence utterly inconceivable. Our belief that the brute creation cannot perceive the moral character of certain acts is an unproved assumption.

Elsewhere the author writes:—"While primitive man had nothing but articulate speech, his individual experience died with him." Does the author mean to convey the notion that primitive man had always articulate speech? Does he hold that experience cannot be transmitted without such speech? We believe that knowledge was to some extent handed down in the human species prior to the development of speech, as we see among the lower animals.

There are other passages on which issue might be joined in the columns of journals devoted to theological, historical, or political questions, but into which we cannot enter. The work, whatever may be thought of the subsidiary opinions here and there expressed, is at any rate a fair, temperate, and clear exposition of the creed of the Agnostic. Those who study it may be preserved from errors misleading to the public and discreditable to themselves.

The School of Mines and Industries, Ballaarat, Victoria, Australia. Ballaarat Science Lectures. First Series, 1882. A Course of Popular Science Lectures delivered in the Lecture-Hall of the School during the Winter of 1882. Ballaarat: James McHutchison.

Of these Lectures several are of decided interest, and may fairly claim our notice.

In a discourse on Alchemy, delivered by Mr. G. Foord, of the Royal Mint, Melbourne, the speaker noticed the belief, common in the days of Queen Elizabeth, that worms, snakes, and eels might be produced by fermentation. It would seem that in some parts of Scotland, even to the present day, it is half-believed that a horse-hair placed in a cask of water will gradually become an eel.

The Rev. T. E. Ick, M.A., gives an able Lecture on the Wonders of Coral Life. His treatment on the subject is fully on a level with the latest results of investigation. He brings forward a teleological explanation of the fact that the trees on a coral island grow densest and highest on either side of the opening into the lagoon, and finds here a special arrangement for the safe guidance of mariners. We would remind him that as "it is an ill wind which blows nobody good," so it must be an exceptional circumstance indeed which has not a useful phase.

Dr. J. F. Usher takes for his subject Human Physiology, under the title "Body and Bones." His Lecture has rather, if we may use the expression, a buffo character. He ventures on the statement—"A physiologist lately declared that he thought he had conclusively proved a certain point after he had vivisected or otherwise experimented on 4000 dogs, but that on similarly experimenting on 4000 more he found his first conclusions wrong." The internal evidence of this case is so doubtful that we must take the liberty of asking whether the authority is Baron

Munchausen or "Ernst Von Weber"? Further, the lecturer tells us that "within the last few months Dr. Koch, a Berlin physician, has proved to demonstration that that fell disease phthisis, pulmonary or tubercular consumption, is due to the presence of a certain parasite called a bacillus." Without entering upon the discussion of this theory, we must remind him that he might have looked nearer home, and found in Dr. W. Thomson, of Melbourne, probably the earliest—and certainly an independent—author of the discovery; for which, however, he has reaped as little *kudos* as did Dr. George Walker, the *true* apostle of sanitary reform in England.

Passing over a handful of jokes and a good sturdy denunciation of tight lacing, we come to the peroration. The lecturer said, if "the undevout astronomer is mad, no less, I think, the undevout physiologist. Yet Tyndall and other great scientists were never thought either mad or pious." We do not see why Prof. Tyndall, the physicist, is here paraded at the close of a Lecture on Physiology, unless it be for the sake of introducing the very threadbare subject of the Belfast Address. Dr. Usher goes on to say—"It is incomprehensible to me how men . . . . nevertheless reject a designer, as everyone must acknowledge who reads Tyndall's Belfast Address between the lines,—rank Atheism, thinly veiled throughout." Might it not be suggested that "reading between the lines" is a very difficult process, by which, moreover, we may sometimes get out of a book something very different from what the author ever put into it?

The lecturer proceeds:—"One great German scientist now lives with altered views, and an eminent French one lately died as we all would wish to die." These are but very vague assertions.

Again, returning to Tyndall, Dr. Usher pronounces him "*facile princeps* of them all," *i.e.*, of men of Science, and even calls him "a man whose discoveries in light and sound alone would make even the great Newton, if now alive, sit as the humblest of his pupils at his feet!" We doubt if many continental authorities would endorse this high-flown encomium.

Baron F. Von Müller, F.R.S., the Government Botanist of Victoria, gives a most interesting Lecture on the Flora of Australia as compared with those of New Zealand, of New Caledonia, of Europe, of Japan, of Chili, of New Guinea, and of the United States. The learned speaker concluded with some remarks which seem to breathe a spirit of hostility to the doctrine of Evolution. His principal contention is apparently that species once extirpated are never restored to vitality. But in like manner the individual defunct animal or plant is never restored to life. Yet this is no argument against the fact that it has gradually sprung from an initial germ!

Electricity and its Uses. By J. Munro. London: The Religious Tract Society.

We have here a popular, but clear and correct, account of electrical science in all its various branches. A work of this kind was greatly needed. We have indeed, in the English language, books which treat of electricity in a manner suitable for the student or for the professional specialist; but if an educated and intelligent non-specialist had asked us to recommend him a book giving a brief and plain account of the recent applications of electricity, of their results, and of the principles upon which they rest, we should have felt no little perplexed.

Hence it is no wonder if the popular notions of electricity are of the wildest. It is credited with the strangest and the most contradictory attributes, and is recommended by those who know least about it for effecting any purpose soever. We trust that some at least of these vain imaginings will fade away into the "infinite azure" as Mr. Munro's little book becomes better known.

The author's plan is very simple: he describes and illustrates the leading properties of the agency in question, and then proceeds to show their applications. Thus we have, first, a sketch of the early history of the science, a notice of the rival hypotheses of two fluids, and of one which, though no longer recognised by electricians, still survives, for convenience sake, in their current language. We are then successively introduced to batteries, to polarisation, circuit, resistance, the electromotive force, and Ohm's law. In successive chapters follows an account of induction, a notice of the telegraph, telephone and microphone, of the photophone and telephotograph, the induction balance, the dynamo-electric machine, the various arrangements for the generation of the electric light, and a summary of its advantages as compared with gas,—once the admiration of our fathers, but to us a mere nuisance, especially where supplied by a monopolist company.

We have next an account of the applications of electricity for the transmission of power and for storing up the effect of certain natural agencies, such as the winds, the tides, waterfalls, &c. It may here be mentioned that Mr. Edison hopes ultimately to obtain an unlimited supply of power from the electric currents of the earth and the atmosphere, thus dispensing with the steam-power and the consequent consumption of coal for setting dynamo-machines in action. The transmission and distribution of mechanical power—just as we now lay on water or gas—rightly seems to Mr. Munro to open up a hopeful social prospect. He writes:—"The great economy of very large steam-engines over small ones has led to the development of large factories, where hundreds of human beings are cooped up amid the incessant roar of machinery and the stifling dust of a polluted atmosphere. But when power has been distributed by wire to this place and that, a blow will have been struck at this imprisonment of men and women in the interests of capital and the consequent deterioration of their souls and bodies."

We fully admit that the factory system has made "wealth accumulate and men decay," and we most devoutly hope that Mr. Munro's anticipations may be fulfilled. But so far all the potential benefits offered us by modern science have been neutralised or turned into curses by modern greed.

The last two chapters treat, somewhat briefly, of electricity as a source of heat, of electro-chemical action, and of medical electricity,—a region in which there is yet much to do, especially as regards taking the matter out of the hands of quacks.

The question may be asked, Why is it that electricians, having done so much for our hearing, have as yet done nothing decisive to extend the action of the noblest and the most important of our senses? Reports, indeed, reach us from time to time of inventions by means of which a picture of what is taking place miles away, or in a closed apartment, may be presented to our view; but as yet this is not confirmed. Another improvement much wanted is the translation of light into some other form of energy, capable of affecting the nerves of the blind, and thus depriving this infliction of its sting. Perhaps some future Edison may solve these problems, and thus eclipse the telephone.

Mr. Munro's book deserves our most cordial recommendation. Amongst its good properties we must not overlook the fact that it has not been written in the interests of cram and examinationism,—the Chinese leprosy now overspreading our country. The volume is admirably got up, and is liberally illustrated.

German Conversation-Grammar, in Three Concentric Courses. A Method for Teaching the German Language thoroughly, and in the Shortest Time possible. Containing Grammar, Exercises, and Reader, with Dictionary. By J. Sydow, Graduate of the University of Bonn. Paris: J. G. Fotheringham. London: Kent and Co. Edinburgh: J. and J. Clark.

Concerning the value of the method of learning the German language as here given, we can scarcely undertake to pass a decided judgment. The author in his Preface states that, though called a "Conversation-Grammar," his work is totally different from those school-books which go by this name. . . . All the translations and exercises, while exemplifying the grammatical rules, embody them in sentences which make sense with one another." By way of explanation he gives in parallel columns two exercises, the one of the kind usually to be found in conversational guides to languages, and the other on his own principle. He points out that the former of these requires a knowledge of the auxiliary verbs, the plural of nouns, and the use of prepositions, thus requiring the expenditure of "more than a couple of months on a work with little or no profit." The other, on the author's system, composed without any case-inflection, can be managed "at least [at most ?] in a month, with an evident advantage for conversation."

The exact meaning of the expression "concentric courses" scarcely appears. The author's English is by no means idiomatic. Thus we read in the Preface :—"The Middle Course completes etymology in a systematical way, altogether with the teaching of the construction of the subordinate clause. The student, having got sufficient knowledge of the structure of the language, ought to become acquainted now with those parts of grammatical construction which if exposed to him at the beginning would only have been a hindrance to his progress. . . . The author believes having treated this matter in a manner so as to enable the student," &c. Various other erroneous or awkward expressions will be found here and there in the book. Still as the author's purpose is to teach German, not English, these defects will not be of great consequence. The number of typographical errors is also very considerable, at least as far as the English words are concerned. Very possibly, however, had the printing been done in England the German portion would have fared at least as badly, whilst in France both would have been murdered.

Longman's Magazine. No. XI. September, 1883. London: Longmans and Co.

The scientific element in this number consists in an interesting paper, by Mr. J. A. Farrer, on the Age of Trees. Our knowledge of this subject is, as the author rightly declares, "little more than guess-work." Neither the girth, nor the number of rings, nor tradition is any safe guide. Concerning the latter Mr. Farrer is decidedly sceptical. To confess the truth, it might be hard to give any proof that the hollow of the Shambles' Oak, in Sherwood, served Robin Hood and his merry men as a place to bestow the carcasses of slain deer till their banquetting hour. Nor would we undertake to show that the "Parliament Oak," of the same region, is the identical tree under which Edward I. and his barons consulted before the final expedition against Llewellyn of Wales.

A short tale, entitled "A Bookman's Purgatory," contains a suggestion. The hero of the story collects stray copies of the youthful literary efforts of men who have since become famous, or at least notorious. Such a collection of indiscretions, to be delicately alluded to on occasion, would be exceedingly useful in an editorial sanctum. Yet, after all, the British public rather admires defiant inconsistency, and would think no worse of an idol because his former opinions were diametrically opposite to those which he now advocates.

Traité Pratique de Botanique; Propriétés des Plantes: leur Utilité et leur Emploi dans la Médécine, la Pharmacie, les Arts Industriels, l'Economie Domestique, &c. Par Ed. Lambert. Paris: Firmin-Didot et Cie.

M. Lambert begins his task with some remarks on the importance of Botany nowise novel, and conceived, perhaps, more in a utilitarian than in a truly scientific spirit. He regrets that so many of the affluent and leisurely classes prefer dissipation of all kinds to the study of Nature. He protests against the mistake of attending only to rare species, leaving the commoner kinds unnoticed. He recommends that botanical excursions should be undertaken in company, which, however, should be select, comprising merely persons of suitable tastes and habits. In public herborisations distraction and amusement are often kept more in view than scientific observation.

The travelling botanist is next advised on the subject of his costume. He is told that light grey is, *per se*, the best colour for clothing, but that "the naturalist, less than any other traveller, should render himself conspicuous. This caution is not to be despised, for with a great part of mankind any person whose aims and pursuits are unknown is regarded with suspicion.

We next find certain rules to be observed when travelling. These regulations are of course adapted to the laws and customs of France. Thus we read:—"The character (*qualité*) to be assumed on the journey is not a matter of indifference; that of a soldier, a merchant, even that of a naturalist, exposes you, under certain circumstances, to delays and questions on the part

[*] Practical Treatise on Botany; Properties of Plants: their Utility and their Use in Medicine, Pharmacy, the Industrial Arts, Domestic Economy, &c.

of custom-house officials and gensdarmes, and even of gamekeepers, which it is well to avoid. The character of a Professor is the best for avoiding impertinent questions."

In the British Empire, fortunately, a man is not asked, when travelling, as to his profession or his purposes, though in the home kingdoms the gamekeeper is sometimes very rampant and troublesome. But on the Continent any gensdarme is at liberty to examine the traveller, and so on frontiers is the revenue-officer. We once, on the Austrian boundary, routed a troublesome member of this fraternity by opening under his nose a box containing some live specimens of the salamander. "Holy Nepomuck, pray for us sinners!" was his ejaculation, as he rushed frantically away from animals supposed so deadly.

M. Lambert's advice to the travelling botanist is singular:—"I recommend to carry with you a bottle of ammonia and another of volatile alkali, in case of experiencing sunstrokes, the stings of insects, of vipers, the bites of rabid animals, &c."

"Volatile alkali" is generally regarded as an antiquated synonym for ammonia, though some, we believe, apply it to ammonium carbonate. We can certainly recommend it for the bites of vipers and for the stings and bites of many insects, though not for that of the harvest-bug, which requires the application of dilute carbolic acid. For the bite of a mad dog its value would be trifling indeed.

After instructions on the choice of paper and presses, the author points out the seasons most advantageous for the field-botanist in the different parts of France, with regard to such stations as walls and ruins, fields and meadows, woods, marshes, mountains, and the sea-shore.

After this introductory matter, much of which will prove very useful to botanists travelling in France, the author proceeds to a systematic account of the vegetable kingdom arranged according to their families. The structural characteristics of the most important forms are shown by means of numerous illustrations, and the geographical distribution of each family is not forgotten. A very convenient feature of the book is that it gives the French trivial and local names of the principal plants, in addition to the scientific nomenclature.

The author does not enter into vegetable physiology. He regards also apparently every species as an ultimate and independent fact. Hence he belongs, apparently, to the Old School of Natural History, with its characteristic limitations.

Honour to whom Honour is Due. Edward Davy and the Electric Telegraph, 1836 to 1839. By J. J. Fahie. Reprinted from the "Electrician," Vol. XI., 1883. London: James Gray.

Short Memoir of Edward Davy, M.R.C.S. By Henry Davy, M.D. Reprinted from the "Electrician," No. 11, Vol. XI., 1883.

These two pamphlets may be most conveniently noticed together. It appears that even in this enlightened age not merely the emoluments, but even the honour of an invention, are not equally distributed. We have been familiar with the telegraph for nearly forty years, and we have heard no little discussion as to the comparative merit of its originators and improvers; but till quite lately none of us heard of one who may fairly rank as an independent co-inventor, even if he did not actually anticipate Cooke and Wheatstone. In the documents before us it is expressly stated that Davy had a clearer grasp of the requirements and capabilities of an electric telegraph than probably Cooke and Wheatstone themselves! In 1837 he predicted the use of submarine cables, hinted at the telephone, or a system of "electroloquism" as he called it, and prophesied that the "Government would adopt the telegraph as a part of their postal system. In 1836 he had a clear knowledge of the fact that the effect of the current on the needles could be increased by multiplying the convolutions of the coil. Into a knowledge of this fact we read that "Cooke and Wheatstone and Morse blundered painfully." In Davy's MSS. which have recently come may be traced the principle of the axial magnet used in Royal Houses' telegraph, the germ of the Morse system and of the Brown and Allan relay.

We may now ask who was this Edward Davy? Though a West-country man, he does not appear to have been connected with Sir Humphry Davy. His father, Thomas Davy, of Ottery St. Mary, was a pupil of Sir Astley Cooper, and had an extensive medical practice. Edward Davy was educated as a surgeon, but a so-called medical practice which his father bought for him in the Strand turned out to be merely the business of a pharmacist. He published a small book entitled "Experimental Guide to Chemistry, improved several articles of apparatus, and issued a trade-catalogue of chemical appliances and chemicals. About 1835 he began to experiment on the electric telegraph, and with astonishing success; but, like many men of genius, he had no business capacity. He exhibited his machine in Exeter Hall before it was patented, and his exhibition, as is here stated, was visited by Cooke, Wheatstone, &c. What made his invention a failure, as far as he himself was concerned, was his emigration to Australia in 1839, considering that his invention was completed, secured, and made known, and that nothing remained but negotiations which might be left to agents. The agents, however, did not push the matter, and so Davy's patent fell into the background. It is interesting to add that the inventor is still living in Australia, honoured and prosperous. For many years he was assayer to the Mint at Melbourne, and for the last quarter of a century he has carried on, in partnership with one of his sons, an extensive medical practice. But until the recent discovery of his MSS. (of the existence of which the family were not aware) by his nephew, Dr. H. Davy, of Exeter, and their examination by Mr. J. J. Fahie, his claims as the inventor of an electric telegraph had lapsed into oblivion. His models and apparatus had been sent down to Ottery St. Mary in 1840, and stowed in an outhouse. By occasion of a removal, about three years ago, they were sold as old metal. Mr. Fahie could only find half-a-dozen old Daniells, and a few pieces of copper-wire. His MSS., we are happy to learn, will shortly be committed to the safe keeping of the Society of Telegraphic Engineers.

The Prophylactic Power of Copper in Epidemic Cholera. By ARTHUR DE N. WALKER, M.D. London: Epps.

THE recent revelations of M. Bailly, showing that workers in copper do not enjoy any uniform immunity in case of cholera, render it unnecessary for us to discuss this pamphlet.

CORRESPONDENCE.

⁎ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

SEX INFLUENCE ON THE DEVELOPMENT OF SPECIES.

To the Editor of the Journal of Science.

Sir,—If we stop in our progress backwards where the Kingdom of Nature first carries on its evolutions by the outcome of the contact of two opposites, at the first "female" and "male" existence (however such a difference originated, if we can conceive a state where it did not exist), may we not cast about for a solution there for the origination of varieties, species, and, in the end, sub-kingdoms? Of course it may be objected at once that, when such a state was arrived at, the stone had been set rolling, and the inherency of development was in being. But what I am arguing is, how much the opposite influence of the individuals of each pair of the same variety has affected the opposite sex in the offspring.

It is a matter of astonishment that the animal kingdom always produces itself so faultlessly, when we look at it; and yet why should it be otherwise? It must be admitted that development has been very minute in each stage, and of wide interval. The question remains, What is it that has given rise to any variation, any accident, any monstrosity (as it is)? A long way on we might think a pair's constitution was so weak that it failed to bring forth its own likeness exactly, but something partly like itself and partly like a remote ancestral form, up to which stage of development the constitution of the parents has only strength to bring it; for surely a more highly developed existence requires a great effort of the constitution, or a "something" vital?

But when we notice the effect of crossing very near varieties, such as different kinds of sheep, for instance, is not the decided predominance of the male, or the greater predominance of the female, in the offspring surprising and suggestive? They are no mean halves of the two, as any treatise on breeding will inform us. With domestic pigeons, if two differently coloured birds be paired, the one or the other is often strong enough in "something" to produce its own colour in the offspring. I have crossed a yellow Jacobine (a prize bird) with a common blue hen, and in one nest I have had blue young ones like the mother, and in the next yellow ones with white head and tips (and a very poor ruff). This shows a wavering of the two constitutions, though I believe some pairs breed a constant result in colour, often neither like one nor the other. The age of the respective birds seems to have an effect on the sexes as well.

And let us look amongst ourselves: it is in every one's observation to see, in different families. how some all "take after their mother," or "after their father," in particular physical and physiological items, often all on one side. There is a stronger —what? in one parent. Nor is it absolutely a matter of health, as many know to their sorrow; for evil seems to dog the steps of man far more than good does!

It may be admitted, one would think, that this "cross"—so to speak—of the sexes has its influence in producing varieties. The first variety must have originated in the same kind of individuals, when there were no opportunities for crossing; and if it *must* have been so once, who can say how important a factor it has been since?

Two constant proportions of atoms in chemistry will give a constant result; vary one ever so slightly, and you get nothing, or a very distinct result—a "new variety." And although it seems very far-fetched to consider human beings as two chemical elements, it is easy to see, howsoever one may acquire a slight over-proportion of this mystic "something," the result must be a new variety.—I am, &c.,

D. Yewdall Cliff.

MODERN INVENTIONS ANTICIPATED.

To the Editor of the Journal of Science.

Sir,—Having read with much pleasure, in your September issue, Col. A. Parnell's article on the "Origin of Lightning Rods," I was surprised to find that, according to M. A. De Rochas ("La Nature," 1883, p. 381), Franklin must have been anticipated in very remote antiquity. It is said there that the ancient Etruscans understood the art of guiding the lightning. Servius relates that in ancient times the priests caused their sacrifices to be ignited by lightning. Tullus Hostilius on such an occasion was struck dead because he neglected the precautions given by Numa.

The same author shows also that burning-glasses have been known from time immemorial, and are mentioned in the "Clouds" of Aristophanes, whilst a plano-convex lens has actually been found in the Ruins of Nineveh.

M. De Rochas, in an earlier portion of the same volume of "La Nature," mentions also that fire-engines were known to Hero of Alexandria, and were described by him clearly in his "Pneumatika." They were improved, according to Vitruvius, by Ctesibius, and were hence known as the Ctesibian machines. In the Dark Ages they were lost sight of, and were re-invented at Augsburg early in the sixteenth century.

Now, Sir, I would not have troubled you with a mention of these facts were they merely historical curiosities; but they seem to me instructive. They prove that useful arts and practical inventions, and perhaps a body of Science from which they were derived, may be lost sight of and afterwards may be re-invented. Hence it is at least possible that arts may have once flourished which have been forgotten, but have not been recovered. In any case it is certain that the career of mankind has not been one of unbroken "progress."

I may venture, further, to suggest that the occult knowledge claimed by certain mystics may be simply a more or less fragmentary relic of what was once commonly known. Have we not in the above, too, a natural explanation of the miraculous "fire from heaven" which occurs in the mythologies of various nations?—I am, &c.,

A LUCRETIAN.

INJURIOUS INSECTS.

To the Editor of the Journal of Science.

SIR,—I was much surprised to find, a few days ago, the folllowing assertions in a widely-circulated paper:—"Wherever these troublesome pests [apparently house-flies] abound we may always find consolation in the knowledge that they absorb impurities which would otherwise cause far more serious inconveniences than any that can be fairly ascribed to the buzzing restless little pests themselves."

Again, in the same leaderette is to be read—"If the daddy-longlegs cannot give so good an account of himself as this, he can at all events defy the breath of slander to sully the harmless reputation of his brief existence." (! !)

To take the latter of these two assertions first, I noticed many years ago that the daddy-longlegs, when in the larva state, cuts off seedling plants just under the surface of the ground, so that they perish. On referring to standard authorities to see if the observation was novel, I found it recorded by Professor Westwood, as far back as 1840, in his " Modern Classification of Insects," that "This is particularly the case with *Tipula oleracea*, the larvæ of which sometimes thus completely lay bare wide tracts of meadow." Anyone who consults more recent authors on Economic Entomology—*e.g.*, Miss Ormerod—will find that this supposed " harmless " creature for destroying grass and corn may rank with the wireworm.

The theory that house-flies and other Dipterous insects are safe and useful scavengers is equally erroneous. They "absorb" putrid and morbific matter, and convey it into our food and our very blood, and thus convey carbuncle, ophthalmia, leprosy, &c., from one patient to another. This I submit is a somewhat " serious inconvenience." One of the saddest features of the day is that persons come forward or are set to write on subjects about which they have no special knowledge.—I am, &c.,

S.

THE APPOINTMENT OF A PUBLIC EXECUTIONER.

To the Editor of the Journal of Science.

Sir,—Surely in these enlightened days an appointment of such importance as that of Public Executioner will not be left to " influence or nepotism." I hope to see the announcement in due form that an " open competition " will be held, and that intending candidates must prove their competency by submitting to an examination.—I am, &c.,

R. M. N.

NOTES.

Biology in the German, Austrian, and Swiss Universities. Winter Semester.—The following Professors and Assistants give instructions in the different departments of Biological Science:—

Basle: Rütimeyer, natural history of the Vertebrates; Vöchting, general botany and microscopy; Griesbach, general and special zoology.

Berlin: Schwendener, general botany; Westermaier, vegetable physiology; Magnus, botanical colloquia; Von Martens, systematic zoology and zoological colloquia.

Bern: Fischer, botany; Bachmann, palæontology; Studer, general zoology and zoological exercises.

Bonn: Pohlig, fossil Mammalia; Schlüter, introduction to original work in palæontology; Strassburger, special botany, microscopic botany, and introduction to original work; Hertwig, zoology; Bertkan, practice in determining animals.

Breslau: Schneider, zoology and zoological practice; Cohn, fungology, principles of general botany, and vegetable physiology; Rœmer, palæontology.

Dorpat: Rosenberg, evolution of the Vertebrates; Grewingk, palæontological practice; Klinge, general botany, determination of plants, and botanical excursions.

Freiburg: Hildebrand, microscopic botany; Weismann, zoology; Gruber, zootomical practice.

Giessen: Hoffmann, vegetable physiology and general botany; Ludwig, zoological practice,

Graz: Leitgeb, general botany; Von Ettingshausen, vegetable palæontology; Haberlandt, vegetable physiology; Schulze, zoology, with demonstrations and work in the Zoological Institute.

Halle: Von Fritzsch, palæontology; Grenacher, systematic zoology and animal morphology.

Heidelberg: Bütschli, zoological practice and demonstrations; Kossmann, zoological laboratory; Pfitzer, systematic botany and work in the Botanical Institute.

Jena: Preyer, physiology, introduction to research in the physiological laboratory; Haeckel, zoology, with practice and introduction to research; Stahl, principles of botany, practice, and research; Detmer, experimental vegetable physiology.

Kiehl: Möbius, zoological practice; Engler, vegetable morphology and physiology.

Leipzig: Schenck, experimental vegetable physiology; Leuckart, zootomic practice; Chun, zoology; Marshall, the Darwinian theory; Fischer, morphology of mosses.

Munich: Hartig, anatomy and physiology of plants, with microscopic demonstrations, microscopic practice for advanced students; Von Nägeli, systematic botany; Zittel, palæontology; Spangenberg, zoology.

Prag: Gintl, palæontology of the Evertebrates, and the Darwinian doctrine with reference to palæontology; Weiss, general botany, and use of the microscope; Von Stein, general zoology.

Strassburg: Benecke, palæontology; De Bary, work in the botanical laboratory; Schmidt, zoology, and work in the Zoological Institute for advanced students.

Stuttgart: Jäger, zoology; Von Ahles, vegetable anatomy and physiology.

Würzburg: Virchow and Von Kölliker, histology; Von Sachs, vegetable anatomy and physiology; Semper, general zoology.

In these days of cramming for examinations it is pleasant to find a course of teaching carried on purely for the sake of imparting knowledge of any kind. The recently issued numbers of the "Journal of the Quekett Microscopical Club" contain, among the usual matter, reports of demonstrations given during the Session on subjects of importance to microscopists. This is not the first time that this Society has shown its anxiety to provide for the instruction of its younger members. Soon after its commencement, in 1865, arrangements were made for a course of lectures on the use of the microscope, and, thanks to the lecturer and his zealous demonstrators, the pupils acquired considerable knowledge of the manner of conducting histological investigations: so great was the success of this first attempt that in two succeeding years the lectures were repeated, and many of the pupils in the first course were able to render valuable service as assistants in the second and third. During the early part of the present Session the following demonstrations have been given by members who have made a special study of their respective subjects:—"Staining Tissues," one of the most recent and valuable aids to research. "Photo-micrography." "Shore Collecting," a subject upon which very little has been written, and where the experience of a collector accustomed to work on the sea-coast must prove of the greatest value to intending inquirers. "Preparing parts of Insects," a subject full of difficulties to the unassisted beginner. "Microscopic Vision," in which the much-neglected discoveries of Professor Abbe were simply and clearly explained. "Mosses," by a botanist who has devoted his entire energies for many years to the subject. The whole course was, where practicable, fully illustrated, and every attention given to the answering of enquiries, which were very freely made.

Microscopists have not been slow in taking advantage of the introduction of the very sensitive dry plates. Several contrivances by which they can be utilised for the purposes of photomicrography appear in the journals of the various societies. Most of the arrangements are simple in the extreme, and the light given by a well-constructed paraffin lamp is sufficient for obtaining good negatives with all but the highest powers.

Mr. J. Leiter, of Vienna, has constructed a singular modification of the microscope, to which the name of gastroscope has been given. Its use is for exploring the interior of the human stomach. It consists of a metal tube 65 c.m. long and 14 m.m. thick, bent at an angle of 150° at about one-fourth of its length from the lower end. At the lower extremity is contained an incandescent electric lamp for illumination of the interior of the stomach, and an objective at the back of which is a prism to reflect the pencil along the length of the tube; at the bend it is again reflected by another prism to the eye-piece. Provision is made for a circulation of cold water to prevent the lower end of the tube becoming inconveniently hot.

Dr. C. Virchow, in his Inaugural Dissertation, questions the prevalent opinion that the plants which formed upland peat-moors are capable of flourishing only on soils poor in lime.

"Biedermann's Central-Blatt" questions the opinion of Prof. W. N. Hartley, that the colouring-matter of peaty soils is analogous to alizarine.

Dr. T. M. Madden ("Medical Press") points out that, in the short time since the annual reports of the Commissioners in Lunacy have been issued, the proportion of insane persons has risen from 1 in 800 to 1 in 300 of the population. Mental derangement is now more common among women than among men, "one result of that hopeless contest with Nature's laws in which those are engaged who seek to unsex themselves by assuming all masculine pursuits and modes of life."

Cremation has been officially introduced in Brazil in the case of persons who die of yellow fever.

The "Medical Press and Circular" complains with just indignation of the inconsistency of the Legislature in sanctioning pigeon-shooting, whilst suppressing physiological experimentation.

M. V. Burq ("Comptes Rendus") strongly recommeds the internal and external use of copper as a preservative against the cholera.

According to M. B. Delachanal the bitumen of the Dead Sea is distinguished from other bitumens by the presence of sulphur in its composition.

Dr. Jackson, in a paper read before the West Kent Medico-Chirurgical Society, shows that pre-historical man was afflicted with a variety of diseases, including syphilis.

According to the "Medical Press and Circular" the wife of Prince Bismarck is "a trafficker in a nostrum, made from magpies' wings, for the cure of epilepsy"!

At the Glasgow Congress of the Sanitary Institute of Great Britain an address to the working classes was to be delivered by Dr. Alfred Carpenter, of Croydon,—doubtless in glorification of sewage-irrigation.

The Rev. A. Irving ("Geolog. Mag.") contends that the green colour of the Lower and Middle Bagshot Sands is due not to any mineral matter, but to vegetable impurities.

The recently-published observation that meat can be protected from putrefaction by means of carbonic acid was anticipated by Hermbstadt as early as 1791.

At the September meeting of the Entomological Society the Rev. Mr. Gorham read an interesting paper on the Insect Fauna of Japan, showing that it was not formed by immigration, but was essentially endemic.

At the same meeting was exhibited a hermaphrodite specimen of *Macropis labiata.*

Says Dr. H. Rowland, in the Physical Section of the American Association, "It is a fact in Nature which no democracy can change that men are *not* equal."

It appears that Dr. Hermann Kolbe, Professor at the University at Leipzig and Editor of the "Journal für Praktische Chemie," has been sentenced to a penalty of 200 marks for insulting Dr. Georg Krause, of Coethon, Editor of the "Chemiker Zeitung." In Germany it is exceedingly difficult to conduct a controversy without incurring the risk of legal proceedings; but by way of compensation the penalties and costs in such cases are out of all comparison smaller than in England.

Prof. G. Wiedemann, in a very brief notice of the experiments of the "Reichenbach Committee" of the Society for Psychical

Research, speaks of them as the "almost forgotten and already thoroughly refuted experiments of Reichenbach on the so-called Od."

Herr H. Dewitz ("Zoolog. Anzeiger") shows that in so-called apterous beetles (*e.g.*, *Niphus hololeucus*) rudimentary hind wings appear towards the close of the larval period, but become obsolete during the further development of the insect. Hence he concludes that this species once possessed fully developed wings which have gradually become abortive from disuse,—a change which must have modified other parts also.

M. H. Fol ("Comptes Rendus"), in a memoir on the "Origin of Individuality in the Higher Animals," comes to the conclusion that neither the ovum, nor the female nucleus, nor the spermatozooid, taken separately, suffices to determine the individuality.

Mr. J. D. Caton ("American Naturalist") gives an account of a cat which when she had caught a prairie gophir always brought it home to exhibit before devouring it. But when she had caught a bird, for which she had been often reproved, she always ate it in secret.

Mr. E. D. Cope, in the same journal, considers that the non-aggressive and over-harassed Herbivora have developed the higher brain-structure, whilst the inferiority of brain-type of the Carnivora is a well-known fact of present and past time.

It would appear that, as far as the number of members is concerned, the French Association for the Advancement of Science is more successful than the sister body on this side the Channel.

According to H. A. Wieler ("Botanische Zeitung") plants grow more rapidly in rarefied air than at the ordinary atmospheric pressure.

It is significant that official incapacity and corruption should reach their maximum in China, where competitive examinations have prevailed for so many centuries.

In the majority of plants the leaves, according to Haberlandt and Bœhm, exhale more strongly than the flowers.

Mexican meteorites, as compared with those of Europe, are distinguished by their greater magnitude.

Prof. Thomas Meehan finds that trees do not, as commonly supposed, expand on exposure to severe cold, from the freezing of the sap, but contract to a considerable extent.

Herr Munk ("Berlin. Akad. der Wissenschaft") finds that if the cerebral hemispheres in birds are removed, total blindness ensues. If, *e.g.*, the right hemisphere is removed, the vision of the left eye is either entirely destroyed or greatly damaged, and if the right eye is then extirpated complete blindness results.

M. De Lapparent (" Les Mondes ") bases crystallography upon the following principle :—" In a homogeneous crystalline medium the physical properties, variable in general with the directions followed, are identical for all parallel directions, whatever may be the point of departure."

According to Dr. Arthur Christiani light exerts a favourable influence upon the vegetative sphere of the human economy, by increasing the activity of that portion of the brain upon which respiration depends.

M. Weber (" Chem. Central Blatt ") has found that the hydrocyanic acid secreted by myriapods of the genus *Fontaria* is elaborated by certain glands arranged along both sides of the animal. Does this secretion prove a protection against birds, spiders, &c. ?

Foods for infants now rank high among the positive checks to population.

The quack ought to be a patriot out of gratitude, for his country rears him a constant supply of dupes.

Mr. S. Kneeland gives, in " Science," a number of instances proving that crows do occasionally grasp and carry booty in their claws, after the manner of the Raptores.

M. Faye (" Comptes Rendus ") combats the theory of M. Delauney that the planets, especially Jupiter and Saturn, exert a decisive action upon earthquakes.

M. Ramon de Luna, in a communication to the Academy of Sciences, maintains that the cause of cholera is always found in the air, and that it acts upon men through the respiratory organs.

We regret to find that the Social Science Association is about to advocate increased restrictions on the sale of " poisons "—a step which will seriously hamper chemical research and harass various manufactures.

The assertion that a " high birth-rate is the invariable concomitant of prosperity " is refuted by the example of France.

According to Dr. Marloth (" Botanisches Jahrbücher ") almost all seeds are protected against injury from without by the development of thick, dense layers. The strata show such diversity (even in closely allied groups) that their structure is of little value for systematic purposes.

Dr. Freire, of Rio Janeiro, shows that soil from the graves of persons who have died with yellow fever swarms with microbia, which by innoculation produce the disease in animals.

According to "Light" a Mrs. Croad, now of the Clapham Home for Incurables, though blind, is said to distinguish colours by passing the object over her cheek. To her "each colour has its peculiar degree of heat, smoothness, roughness, or projection. White is cold; black, hot or raised; red, very hot and smooth; blue, hot and grating; brown, very grating."

We are informed that on October 12th the Duke of Argyll will deliver a Lecture, in Glasgow, on "Geology and the Deluge."

We are happy to find that Mr. Gerald Massey's Lectures are being attended by large and intelligent audiences.

M. L. Crié ("Comptes Rendus") has made a study of the Eocene Flora of Western France, as compared with that of Alum Bay and Bournemouth.

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I. THE DISTRIBUTION OF COLOUR IN REPTILES, BIRDS, AND MAMMALS.

WE take the opportunity of laying before our readers some of the main results which Herr Eimer has reached in his prolonged investigations on this difficult and interesting subject. To the ordinary observer the patterns or designs recognisable in animals seem essentially lawless,—or at least appear to follow no regular, far-reaching principle. Even zoological specialists have, for the most part, come merely upon a few vague generalisations which carry us but a little way. Thus some of our correspondents have called attention to the parallel bands, at right angles, or nearly so, to the major axis of the body, which may be traced in the tiger, the zebra, and in numbers of beetles and Lepidoptera,—in the latter both in the mature and the larval condition.

Herr Eimer appears to have commenced his studies upon reptiles, and more especially upon lizards. In their manifold and seemingly arbitrary designs he has traced a strict regularity. The patterns in question are reducible to three fundamental forms—longitudinal stripes, transverse stripes, and spots. The first-mentioned of these three styles he considers as the primitive form, from which the two others have been developed by transformation, and are still undergoing changes. There are a certain number of such longitudinal stripes, occupying normal positions, and appearing as the original rudimentary starting-point of all colouration.

On every hand we find species which still display this primitive type of simple longitudinal striping. Others are spotted, and others "tigrated" (Herr Eimer's convenient expression for transversely banded), and between these types there are the most manifold transition-forms. Not unfrequently all traces of pattern or design disappear at an earlier or later stage, leaving the animal concolorous. But even to the present day the species with higher stages of design pass through the lower stages in the course of their individual development. Thus tigrated species are in their youth spotted, and at a still earlier stage long-striped. Certain concolorous species—*e.g.*, the lion—are in youth tigrated, earlier spotted, and earlier still long-striped. Hence Eimer concludes that in primitive ages there existed only striped forms, from which other designs have gradually arisen. We have thus a new confirmation of the biogenetic law, according to which the history of the individual is an epitome of the career of its ancestry.

In these successive transformations Eimer establishes the fact that everywhere the female sex retains a more juvenile colouration than the male, thus remaining on a lower stage of development. Hence the law of "male preponderance." Eimer shows further—and this is a most interesting fact—that the transformations of design take place in a certain direction along the body. In lizards this occurs from behind forwards, so that every new property appears first at the posterior extremity of the body, extending gradually forwards, whilst the original design remains longest in the anterior parts. This rule Eimer calls the "law of undulatory development," and he traces it both in the history of the species and of the individual.

Turning from reptiles to birds, mammals, Lepidoptera and their larvæ, Herr Eimer traces the same three fundamental types of design, and the same relations. In birds, especially, the biogenetic law of colouration and the law of male preponderance are very strikingly manifest.

Young birds of allied genera or species have the same designs and the same colours, even when very distinct at maturity. The females generally retain more or less the original, youthful colouration, whilst the males of the species deviate most widely from each other in their adult stage. We may take as an instance such groups as the thrushes, or the Raptores. In these, and in many other cases, it may be observed that the plumage of the young, and of the mature hen, displays streaky spots following the direction of the length of the body. In the adult male the spots are directed transversely, or disappear altogether, this change being accompanied by a variation in colour.

These relations appear especially striking in birds of prey. The young of almost all European species have a brown plumage, marked with black longitudinal dashes which sometimes form black lines, and are subsequently resolved into longitudinal spots. The females often retain this plumage, but sometimes in them—at least in age—it is transformed into a transverse pattern. In the male this change takes place, as a rule, on the approach of maturity. The longitudinal stripes persist longest on the under surface of the body. The back loses all pattern, and becomes concolorous, first in the male, whilst transverse stripes may remain on the lower side of the tail and the wings, or on the entire under surface. Hence the back of these birds is the first part to display new properties. Numerous instances show that here also, as with lizards, the youthful design persists longest in the anterior part of the body, whilst the new design begins at the posterior extremity and spreads headwards. Sometimes all these stages of transformation may be met with in the plumage of a single bird. Thus the throat may have long stripes, the breast longish spots, which lower down pass into a broken design of spots forming a transition to the transverse pattern, which becomes fully pronounced on the tail, whilst the back has become concolorous. The "law of undulatory development" is therefore as manifest among birds as among lizards.

Herr Eimer summarises his observations on falcons as follows:—In youth, leaving the earliest down out of consideration, as it has generally no design at all, we find a brown ground-colour and a pattern of longitudinal stripes predominate. In the female both these features persist longest, whilst new characteristics appear in the males, and especially in the elder males. The new features appearing are transverse stripes, and a grey, greyish blue, rusty brown or black colour. The transverse pattern appears earlier than the new colour. Each new stage of pattern appears first in the vigorous adult males. The forms with the more advanced characters always pass through the lower stages. The females of each form remain on a lower stage, and generally on the next lower stage than their respective males. Finally, it always appears that the new features, especially the transverse stripes, commence at the posterior extremity and advance forwards, the youthful design persisting longest at the head, whilst the upper surface is changed more rapidly than the lower.

Herr Eimer then extends his observations to the Mammalia, summarising his results as follows:—Among the mammals, also, the distribution of colour may be reduced to long stripes, spots, and transverse bands. The longitudinal stripes are here also the pristine pattern from which spots and transverse bands proceed in turn, whilst as the ultimate stage the pattern disappears and the animal becomes concolorous. The mammalian fauna was originally striped, whilst spotty and tigrated forms appeared in succession, the same changes of design appearing in the same order of succession. Sometimes there appear only transitory intimations of the earlier types; the last is sometimes wanting; sometimes the intermediate also, and sometimes all.

The laws of male preponderance, and of the undulatory propagation of development from behind forwards, have not been so distinctly traced as in birds and reptiles. But a progressive development from below upwards is shown in this manner, that the longitudinal design persists longest in the median line of the back, often as a single stripe, whilst lower down it is resolved into spots or even transformed into bands.

In Mammalia, as well as in other animals, the transformation of the designs takes place according to fixed laws. Not even the most insignificant spot on the body is without genetic or phylogenetic signification. The persistence of the heredity of such marks is extraordinary, and thus here also the design appears a most important means for recognising the affinity of forms, and for a scientific classification.

For further details we must refer our readers to the "Jahreshefte des Vereins für Naturkunde in Würtemberg" (vol. xxxix., 1883, p. 56).

From the uniformities which he has recognised,—according to which the transformation of patterns proceeds, even to the minutest detail,—and from the circumstance that in numberless cases animals and plants produce formations in which the principle of utility can have had no immediate effect, but whose origin may be compared with that of crystals, Herr Eimer concludes that the essential principle of the conversion of forms is a development depending upon constitutional causes, and proceeding of necessity in a certain direction. The principle of utility, though important, is merely a modifying factor. The origin of new species depends, according to Eimer, upon the arrest of forms in various stages of this natural development.

II. ECONOMY OF FUEL IN HOUSE FIRES.

By T. Fletcher, F.C.S.

THE opinion expressed in the September issue of the "Journal of Science" that open fires should be renounced in favour of stoves is one not at all likely to be a general one where the cost of fuel is not excessive. Having for years in succession tested, in actual practice in my own house, nearly every possible system of heating,—by warm-air flues, hot water, close and open stoves heated by gas, coal, and coke, open fires of coke and coal, gas stoves and gas fires,—it will possibly be a matter of interest to some how the series of trials has terminated by the survival of the fittest.

The tests have been undertaken partly as a question of personal comfort and economy, and partly to obtain information for business purposes; and the latter reason has enabled me to carry out the experiments in a much more exhaustive and complete form than is likely to be done by any private individual for his own comfort.

Where a large body of air has to be heated in public rooms, plant-houses, and similar structures, there can be little doubt that hot-water pipes give the best result; and in my own experience the most satisfactory boiler is a simple coil of iron pipe, with the fire in the centre. Where equal and steady heating is required it is advisable to put in the circuit a large tank for hot water, into which all surplus heat is taken and stored. By this means, with the most irregular firing by careless and unskilled servants, the temperature of plant-houses and rooms which require to be kept aired can be controlled with perfect ease and little trouble; but to sit quietly and comfortably in rooms so heated is out of the question, apparenly for the simple reason that the temperature of the floor and lower strata of air is always lower than that of the upper parts, the consequence being cold feet and a feeling of general discomfort.

My own sitting-room—containing my private comfortable corner, special easy chair, and other matters which constitute my den, to which I retire for ease and absence of "bother"—has gone through a series of slow-combustion grates fired with coal, then with coke; grates with warm-air apparatus; grates without warm-air apparatus, supplied with fresh air from the outside, and heated with coal and also with gas; incandescent gas-fires with supplementary warm-air apparatus to utilise the waste heat, and incandescent gas-fires utilising the radiant heat only. The round has been a pretty long one, and it has settled at the indisputable fact that radiant heat, and radiant heat alone, with the freest ventilation, is the only really comfortable and desirable way to heat a room used as a sitting-room and library.

This brings the question down to a choice of an ordinary open fire and an incandescent gas-fire, and the latter has been selected on account of the ease with which it is controlled, its instant readiness, and its total freedom from dirt. Although a complete year's work with this has not been gone through, it is evident that a room 15 × 20 feet can be comfortably and pleasantly heated with an incandescent gas-fire for about £6 per annum, with coal-gas at 3*s*. per 1000 feet, all the warm air being sent up a freely open chimney, the cost being about three times that of a coal-fire, against which may be placed saving of labour and dirt.

In the passages and bed-rooms a purely radiant heat is an expensive luxury which is not by any means necessary, or even desirable; and here we may adopt two systems:—hot-water pipes for the passages, which for economy may be heated by boilers, with a coke fire, like an ordinary greenhouse arrangement; and for the bed-rooms warm-air stoves heated by gas, which have the special advantage of being under immediate control. Why a warm-air stove should be preferred in a bed-room appears to admit of a simple explanation, *i.e.*, that the temperature of the lower strata of air and of the floor is a matter of little importance to persons in a recumbent position, the objection to this being only felt by those who are quietly sitting in a room with a low floor temperature.

I do not find that any person who has a choice between sitting in a room heated by purely radiant heat and one heated by warm air will, under any circumstances, choose the latter, even if the room itself is in other respects far more convenient and comfortable; and so long as a coal or incandescent gas-fire can be obtained at a reasonable cost, it does not appear at all likely that any stove will be adopted in ordinary sitting-rooms, whatever its apparent advantages may be.

III. SCIENCE AND SAVANTS IN MODERN LITERATURE.

SCIENCE is at last winning recognition, if not due appreciation, in a new quarter. Her results, her supposed objects, her methods, and even the personality of her followers are no longer ignored in works of fiction, though whether they are faithfully and fairly depicted is certainly open to question. This change has been of a very gradual character. In the last century there were, as we know, amateur astronomers and *dilettante* experimentalists in physics not a few. Society was deeply interested in the marvels of frictional electricity. Gentlemen of fashion turned back their ruffles in order to apply their hands as rubbers to the revolving glass globe or cylinder; and ladies, in all the glory of patches and hair-powder, discussed, or at any rate gossiped over, the results produced. Yet none of this interest was reflected in the literature of that day. Scientific discoveries and scientific theories are not even glanced at by Richardson, Fielding, Smollett, or their contemporaries. Coming down even to recent times, we may make the same remark concerning the writings of Charles Dickens. Doctors, lawyers, divines, men of erudition are introduced; but for him the investigator of Nature was too unimportant even for ridicule.

In Bulwer Lytton the case is different. Here, in "Zanoni" and in "A Strange Story," we find the search after truth put forward as a pursuit capable of absorbing human attention. But the Science of Lytton is more nearly allied to what is now becoming known as "Occultism" than to the open discipline of Western Europe. Zanoni is a physicist, a chemist, a biologist also, but the extent and the nature of his attainments are veiled over with an impenetrable cloud. He is, at at any rate, neither a picture nor a caricature of any *savant* of Lytton's own time. Nor is the knowledge which he is represented as possessing part and parcel of that which figures in our scientific journals, or in the Transactions of the great learned societies. Be it a reality or a delusion—and this is no place for discussing such a question—it is something essentially *sui generis*. Nor does it appear as a factor capable of influencing the ideas, the beliefs, and the characters of men and women of the world.

In certain modern works of fiction this step is taken:— Persons not engaged in the investigation of Nature are shown as affected by the results of research.

We are not going to deny that, especially since the great Darwinian reform, Organic Science, Biology,—or, as it was formerly called, Natural History,—is found to throw new lights upon moral, social, and political problems, and to influence the convictions of the many. As such, doubtless, it is a perfectly legitimate subject for the novelist, the dramatist, and the poet, as well as for the ethicist and the divine. But it may, we submit, be fairly demanded that the doctrines of the New Natural History, in as far as they bear upon human interests, should be correctly stated, and their influence be impartially weighed.

We must remember that Science does not *do* anything—does not bid us to do anything. Her function is merely to perceive the truth, and to make it known. If we listen carelessly, and accommodate our actions to such half-knowledge, we shall do well to lay the blame where it is due.

These remarks are suggested to us by a modern novel from the pen of a writer who is generally classed among the "sensational" school. Be this as it may, we find in it the following passage:—"He heard all that Brian had to say—he listened to his wild ramblings as to the voice of an oracle; and then when Brian had poured out his little stock of argument in favour of Materialism, had quoted Aristotle and Holbach and Hume and Comte and Darwin, and had perverted their arguments against a personal God into the divine right of man to ruin his soul and body, John ardine, who had read more of Aristotle than Brian knew of all the metaphysicians put together, and who had Plato, Kant, and Dugald Stewart in his heart of hearts, gravely took up the strain and made mincemeat of all Mr. Wendover's philosophy."

Without any further criticism of this passage, we ask what are Darwin's "arguments against a personal God"? In what chapter of his works do they stand written? We must confess that they have never come under our notice. Nor can they have struck those eminent men who—both at Darwin's funeral and subsequently—have declared that there is in his writings nothing inconsistent with Christianity. Not a few foreign writers have expressed themselves surprised—we will not say disappointed—with the entire absence of anti-religious polemics in the "Origin of Species" and the "Descent of Man." Surely then Miss Braddon, before writing the passage above quoted, would have done well to hesitate and enquire. As it is she has merely helped to strengthen the odium which in many quarters is still entertained against Evolutionism.

In another passage we read, as touching the same Brian Wendover, "He had just that thin smattering of modern science which enables shallow youth to make a merit of disbelief in all things beyond the limit of mathematical demonstration. He had skimmed Darwin, and spoke lightly of mankind as the latest development of time and matter, and no higher a being, from a spiritual point of view, than the first worm that wriggled in its primeval slime. He had dipped into Herbert Spencer, and talked largely of God as the Unknowable." Here, again, it may well be asked whether the denial of the traditional origin of man as a being distinct, *toto cœlo*, from the rest of the animal world, legitimates the conclusion that he is, from a spiritual point of view, no higher than the first worm? All believers in Evolution maintain that man has been developed spiritually as well as physically. It is of course open to Miss Braddon to pourtray a character, like Brian, holding the views here implied; but she should have been very careful to show that the dreams and the talk of a fast young man, haunted with *delirium tremens*, are no natural consequences of a study of the writings of Darwin and Spencer.

We do not deny that in the natural sciences, as elsewhere, superficial knowledge is a dangerous thing, especially when over-rated by its possessors. To show the wrong that Miss Braddon has here done to modern science we need only ask what impression will be left by a perusal of the passages quoted? Let the book be read by a clergyman, a schoolmaster, or a parent unacquainted with Darwin's works, will he not shake his head and pronounce them most dangerous and most improper to be put into the hands of young people?

We do, however, find Darwin and his compeers presented in a somewhat different light. Concerning a certain most disagreeable young lady, and her plausible father, a duly qualified charlatan, we read:—"You remember with what a firm hand he managed her in days gone by. Well, after she took to Huxley and Darwin, and the rest of them, that was all over. She was always tripping him up with some little shred of scientific knowledge, fresh from Tyndall; always attacking his old-fashioned notions with some new light." Surely if modern research can be presented to the reader merely as furnishing a weak-minded idler with excuses for his vapid immorality, and as enabling *ci-devant* young ladies to mystify themselves and others with half-understood incoherencies, it had better be left out of consideration altogether. Might we therefore beg novelists, if they find it necessary to notice Evolutionism, to show its true influences in the person of some working naturalist who uses it successfully as a key to the problems of the organic world? A Weissmann, a Bates, a Fritz Müller among the living, or a Balfour and a Belt among the dead, might serve as types.

There is yet another manner in which Science is made to figure in the pages of modern fiction. In the good old times when discovery, or the attempt at discovery, was a criminal offence punishable possibly with imprisonment, or even death, there were substantially no novels. Still we have no doubt that the unfortunate sages of those days were sneered at and maligned in polite society no less emphatically than they were execrated in convents and colleges. Now this is all altered: we have no longer the open persecution, but there is an organised attempt to render investigation in one important direction impossible. This movement has unfortunately met with the adhesion of not a few novelists, who are carrying on the war in a characteristic fashion. There are no substantial arguments which may be met, no alleged facts which may be proved altogether fictitious; but there are innuendoes which, falling, as they usually do, on ignorant minds, will too often take root. We need only refer to a recent tale by the editor of "Longman's Magazine," in which an attempt is made to place physiological experimentation in an odious light. How many of the multitudes who read that popular serial will know, or will care to find out, the real truth of the question? In making attacks of this kind men of Science are placed at a difficulty. We cannot issue counter-novels in which the Bestiarian agitator is shown up in his unscrupulousness, his inconsistency, his ignorance, and his mendacity. We have scarcely the funds, like our enemies, to hire light writers to plead our cause. Our pamphlets and justificatory documents, however decisive in themselves, fail to reach the persons who have read the attacks.

So far, then, Science has very little scope for congratulation on the part she is made to play in fictitious literature. She is introduced, it would seem, mainly to be misrepresented and attacked.

IV. ON THE ORIGIN OF THE CELLS OF THE HIVE BEE.

THE cell of the hive bee has for many centuries called forth the wonder of naturalists, and indeed of all observers. Why should, or how should, so comparatively humble a creature in the construction of its comb select that precise form which offers the greatest economy of form and material? Granting that the bee possesses no inconsiderable share of intelligence, we can scarcely conceive of her having made sufficient progress in the higher mathematics to select knowingly the precise angles which are best adapted to the object in view. Hence not a few writers, even to the present day, maintain that we have here a typical case of "instinct" in the old acceptation of the word,—that is, of blind, unconscious, untaught action, producing results which man can only reach by dint of highly cultivated reason. So many of these so-called instincts have lately found a scientific explanation that naturalists of the Old School have recognised the cell of the bee as one of their last entrenchments.

It is therefore very satisfactory that Herr K. Müllenhoff* has found a quite simple and satisfactory solution of the question, which neither admits of any mysterious instinct nor—on the other hand—credits the bee with the knowledge of the differential calculus.

Taking first a preliminary view of the case, we find that Pappus, fifteen hundred years ago, noted that bees constructed their cells in the form of regular six-sided columns, and proved mathematically the superiority of this shape to any other. In the last century Maraldi, and after him Réaumur, examined the form of the middle plate of the entire comb,—*i.e.*, the bottoms of the cells formed each of three rhombs. At the instigation of Réaumur the mathematician König, in 1739, found by calculation the most suitable—*i.e.*, the most economical—of all possible forms for the middle plate, and ascertained that it must consist of pyramids formed by three rhombs having at the apex the angle 109° 28′. Maraldi had found this as the very angle actually employed by the bees.

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* Naturforscher und Berlin Entomolog. Zeitschrift.

These investigators show that each cell represents a six-sided column, bounded at the middle plate of the comb by a three-sided pyramid; the edges meeting at the deepest point of the cell form angles of 109° 28′; other angles of the same magnitude are enclosed by the short side of the hexagonal column and the two adjacent sides of the rhombs. In the terminal points of the long sides of the prism there meet, therefore, four edges at angles of 70° 32′. The arrangement of the wax plates which compose the entire comb may therefore be formulated as follows:—1. On one edge there intersect each other each time three films, and these form with each other equal angles of 120°. 2. At the terminal points of the short sides of the prism meet in each case four edges at angles of 109° 28′. 3. In the terminal points of the long sides of the prism four edges cut each other at 70° 32′.

These properties correspond almost exactly with the laws which Plateau has discovered for his equilibrium figures,—namely, at a liquid edge there intersect each other never more than three films, and these form with each other equal angles, and when liquid edges intersect each other in the interior of the figure they are always four in number, and form with each other equal angles.

Cells of exactly the same arrangement and the same angles as the cells of bees are obtained if numerous soap-bubbles of equal size are suspended in two parallel frames, and if the two systems of bubbles are approached until they touch each other. The soap-bubbles flatten themselves and form hexagonal prisms, terminating in Maraldi's pyramids, at the meeting-points of the two systems. The uppermost row of bubbles (that attached to the frame) would take the form of five-sided pyramids,—*i.e.*, the exact form of the cells which are attached to the woodwork.

The conclusion is, therefore, very natural that this absolute agreement in the respective forms of the soap-bubbles and of the bees' cells depends on similar physical conditions in the construction of both.

If we observe the bees when building their comb, we find that, underneath the board to which it is attached, at least a dozen bees are clinging on each side, in such a manner that the heads of the bees on one side of the comb are exactly opposite to those on the other. As each bee, holding a ball of wax in its jaws, presses as far as possible upwards and forwards, the ball is converted into a plate by the pressure from both sides. At first this plate is not level, but is bent up and down corresponding to the pressure of the numerous heads of the bees, As the bees press forwards the heads, as they meet, must always make way for each other in the direction of the least resistance,—that is, in a newly-begun comb a bee on one side is pressed downwards by its two competitors so as to come with its head exactly in the middle between three who stand opposite. As each bee on the one side presses with its head into the space between the three coming to meet her there is formed, by the pressure to which the soft wax is exposed, the middle plate so much admired on account of its "highest purposiveness." The pyramids of Maraldi are merely Plateau's equilibrium figures extended between the terminations of the sides of the prisms just commenced!

The "instinct" which the bees display is very simple; they press on with their wax upwards and forwards in two perpendicular layers. Of a skilful treatment of the wax there is no trace. The Maraldi pyramids are formed purely on physical principles, not by the conscious activity of the architects. The form of the head of the bee has no meaning as far as the shape of the bottom of the cell is concerned, since, in consequence of the high temperature produced by the respiration of the bees and the continual pressure, the wax is plastic in a high degree.

In an analogous manner the sides of the prism are also produced by the pressure which the cylindrical body of each bee undergoes from the six bees arranged around her on the same side of the comb. The process is exactly as when cylinders of equal thickness are formed into six-sided prisms by an equal pressure.

It appears that the procedure of each single bee is exactly the same as if she wished to construct a hollow cylinder. In fact, if we give them a thick cake of wax they bite and press in it round holes. When they work with an excess of material, as is often the case in the cells of drones, each single cell is a cylinder with a hemispherical bottom. If in such cells, which resemble test-tubes, the excessive substance is removed, the walls both of the prisms and the pyramids gradually take the usual form.

On an examination of a royal cell it appears, also, that the individual bee understands merely how to construct a hollow cylinder with a hemispherical depression at the end.

The fact that the bees frequently, and without any perceptible order, gnaw holes into the outer wall of the thick mass of wax of a royal cell, which naturally turn out hemispherical as the counter-pressure on the opposite side is wanting, shows that their artistic skill does not take a high rank.

When the cells are filled with honey, or with full-grown larvæ, they are hermetically closed with a lid of wax. The covered cell has then, as appears from numerous measurements, the exact form of the soap-bubbles above mentioned. The cells of the *Melipona* and those of single combs are also quite similar to soap-bubbles. The detached "honey-pots" of the *Melipona* are globular, like a freely suspended bubble. If two such cells touch each other they become flattened at the point of contact. Three such cells, if sufficiently close together, take such a form that their planes of contact intersect each other at an angle of 120°. If numerous soap-bubbles, of equal magnitude, are arranged in a single plane. they approach the form of wasps' cells. The phenomena of cohesion in the paper of wasps' nests differ entirely from those of water and of wax, and produce a dome-shaped cell-bottom and cover. If a stratum of soap-bubbles is suspended vertically, and is brought in contact with a second similar stratum, the form of the ordinary double comb of the hive bee is produced. The agency in the formation of these kinds of cells is to be sought not in a skilful movement of the jaws of the insects, but exclusively in physical causes. These are, in the case of wax, that the plastic and viscous material—just as is the case in soap-bubbles—gives way until a given space is enclosed by a minimum of surface. Hence planes are formed like those of Plateau's equilibrium figures.

The shape of the cells can no more be sought in the bodily structure of the bees than in their architectural skill. In view of the plastic character of the material and the manifold impulse to change of form connected with life in the hive, the cells must soon, if equally arranged, take the form of six-sided prisms terminated by Maraldi's pyramids, even if the bees had globular or conical bodies.

Here Müllenhoff is rather inclined to assume that the general bodily form of the *Melipona*, the bee, and the wasp, has been modified by the arrangement of their cells.

V. "PROGRESS" FROM AN EVOLUTIONIST POINT OF VIEW.

By Frank Fernseed.

If once we recognise that the forms of organic life, such as we now find them, have originated by a succession of gradual changes, we cannot fail to be struck with certain analogies between the origin of species and the rise and growth of human society. Social and political thinkers have by no means overlooked this consideration; but they have for the most part erred from an insufficient acquaintance with Evolution, or rather Transformation, as it exists in the animal and vegetable world. Setting out from such imperfect knowledge they have assumed that change may be traced everywhere; that such change is always from an inferior to a superior condition, and that it can or may take place in one direction. These notions, more or less distinctly formulated, are involved in the idea of "progress" as we find it put forward in speeches and sermons, in leading articles, and even in independent works. Unfortunately these views are flatly contrary to the analogies of Nature, and are hence misleading in speculation as in practice. If we make even a moderately careful inspection of the world around us,—such an examination as may be fairly demanded from an educated non-specialist,—we find, on the contrary:

1. That the general truth of Evolutionism, notwithstanding change, is not a universal law of Nature.
2. That where changes occur they are not always serial, moving on in some given direction, but cyclical or periodic, returning to their original starting-point.
3. That where change or transformation shows no appearance of returning upon itself, it is not always from a lower to a higher grade, but frequently in the very opposite direction.
4. That changes, be they for the better or the worse, are not necessarily in one direction only, like the prolongation of a line chalked upon a board, but may take ramifying courses like the branches of a tree.

These four points we will endeavour to unfold and illustrate, pointing very briefly to the practical conclusions which each necessitates.

1. In many respects the scientific inquirer finds not change, but permanence, to be the manifest law of the universe. The expression "Constants of Nature" has already become stereotyped. If we examine the atomic weights, or the specific gravities, or indeed generally the physical and the chemical properties of the different kinds of matter, we find them unchanging. From no fact known, from no circumstance suspected, or even conceivable, have we ground for doubting that the attributes of pure iron, or gold, or sulphur, were in the slightest degree other ten million years ago than what they are at present, or than what they will be ten million years hence. Here then is permanence, not progress, on a vast scale and in matters of grave importance.

But even in the world of life change is not universal. Species, indeed, have sprung into existence, and have passed again away, leaving merely their imprints in the "great stone book." But other forms which flourished in remote geological ages have not thus passed away, but still survive. To resist change, or the impulse to change, is therefore not *per se* a struggle against Nature.

2. We have said that change, transformation, where it occurs, is often cyclical. Instances of such change are almost too common, too familiar to need or even to permit of especial mention. All the variations of the seasons, all the changes of climate which we experience when traversing the earth's surface, are of this character. By going on we merely return to where we set out. But periodic change is the essence of individual development. The young animal passes through a series of changes, which may be described as a movement in the direction of perfection. It increases in size and strength; its various organs are matured, and become capable of exercising their functions; its individuation as compared with the outer world is complete, and then ——? There follows a gradual decay in every respect, as was expressed by the old moralists when they compared the life of a man to a day or to a year. Be it noted that when once maturity is reached in the life of the individual it becomes his object, if desirous to make the best of life, to resist, or at least to retard, that series of transformations —certainly not to accelerate or force them on—the last term of which is death. The judicious man, when once he has reached the end of his "golden decade," husbands his strength, avoids every outlay of vital force for purposes of small moment. Nay, we may go much further, though it

would be suicidal and decidedly criminal to check or traverse natural development in the earlier portion of life, yet no judicious, conscientious parent or educator seeks to hasten on the natural series of transformations. To foster in the child the thoughts of the youth, or to demand from the latter the deeds and endurances of the man, is a capital error. One of the deadliest sins of the modern organisation of society is that it sends young people to the workshop and the counting-house when they ought to be at school, and in return grinds them in "standards" when they should be at play.

Proceeding from these analogies we may well ask whether in human communities, or in human society altogether, there does not come a time when change, if it occurs at all, is not regress rather than progress? Whether it does not become good policy to resist, or at least retard, such changes instead of stimulating and urging them on? Perhaps the essential principle of vigorous individual life may be looked upon as a kind of cohesive impulse which holds all the parts of the animal together in intense sympathy. As life decays this is no longer the case; individual unity, as contrasted with the outer world, grows feebler; injuries are less promptly repaired, and at last the system ceases to be a unity and is resolved into the general mass of matter, undistinguished and undistinguishable.

Very similar is the course of things in a human community: in its earlier days there is intense vitality or individuation pervading the whole; gradually, as maturity is reached and passed over, this principle, which is known in a community as tribal instinct or patriotism, fades away; its different members feel less and less mutual attraction, and finally reach, in cosmopolitanism, a state closely analogous to the decomposition of the animal body and its cessation to exist as an individual.

We find that the de-individualisation of the animal or plant is effected, or at least greatly accelerated, by certain microbia which set up in its tissues fermentations,—in other words, disease processes. If such germs have any degree of consciousness—and it might be unsafe to deny this altogether—they may possibly believe that they are doing an exalted and noble work, and leading the body which is the seat of their operations to a higher vitality. Are there not, in like manner, social bacilli, disease-germs which set up fermentations—*i.e.*, agitations—in communities, and lead the body-corporate in the same path of decomposition? It is to be remarked that certain advanced thinkers on social questions openly maintain that where the rights or the interests of the individual man come in collision with those of the community, the latter must give way. They sacrifice thus the complete animal to some cellule of its body, encouraging in the latter a mutinous local vitality,—a disease process. How utterly different is this procedure from the order of Nature! She sacrifices with little scruple numberless individuals in her attempts to raise the type. They, fancying perhaps all the while that they are obeying her guidance, are ever ready to damage community, race, species itself, for the convenience of the individual.

3. The commonest error on the subject of "progress" is the supposition—tacit, if not stated in so many words—that every change, every departure from what at present exists, must be for the better.

Leaving out of sight those transformations, already noticed, which in the individual lead to death, we find innumerable instances to the contrary, both in the early life of individuals and still more in the career of species. Degeneration, as has been shown by Prof. E. Ray Lankester, and by Prof. Dohrn, of Naples, has played a very marked part in the genesis of species as we now have them. Thus almost all the parasites, external or internal, are degraded forms whose forefathers, more highly organised, once led an independent existence. Thus the various species of lice are supposed, on good grounds, to have once been hemipterous insects whose wings have become abortive, and whose structure has in other respects grown ruder and lower. The fleas are in the same manner degenerated Diptera.

The parasitic group of Crustaceans commonly known as Epizoa are in their earlier stage capable of locomotion, and possess eyes and antennæ. When mature they lose their organs of motion and sensation, and become permanently attached to the skin of fishes, &c. Here, therefore, the mature animal is lower, simpler than it was in the larval condition.

Even in species which perhaps upon the whole are higher than were their remote forefathers, some organs are generally found to be in a degenerated condition.

Thus Nature continually gives the lie to the assumption that all change is in an upward, forward direction. Her transformations sometimes end in converting an active sensitive creature into a "barnacle,"—ridiculed by those who do not know its life-history as the very type of "standstillism" and anti-progress!

There is here at hand another consideration which must not be overlooked. In turning over the evidences of extinct faunas we often come upon the traces of some highly-specialised animal group, strong, fierce, formidably armed, and possessing as it might seem every attribute needful for success in the great struggle for existence, and for transmitting its descendants down to the present day. Such a group, for instance, was that of the Machairodon, or sabre-toothed tiger,—a form including several species, distributed over North America, Europe, India, and probably over other parts of the globe. Yet it has "died and left no sign." No Machairodon survives, nor yet any Carnivore which can trace its descent to this terrible monster. The dominant forms of the present day seem to have sprung from species less powerful and less specially endowed for a life of rapine. The principle involved in these facts has been embodied by Prof. Cope in the "doctrine of the non-specialised." The meaning of this doctrine may, we think, be gathered from the case of the Machairodon. The ascending line of development proceeds not from the more specialised forms who at their time seem the highest beings in existence, and qualified to become the progenitors of still superior types in the future, but from some species or group of species of less striking attributes and of a more generalised character. The suggestion has been thrown out, we believe, by Prof. Cope himself, that the same principle may be traced in the career of human communities. If we take a survey of the world at intervals of say a thousand years, we shall find that not only nations, but races, occupy a very different position at any such survey from what the former survey would have led us to expect. Who, for instance, looking a thousand years ago upon that race which is conventionally called the Anglo-Saxon, would have ventured to give a forecast of the part which it has since played in the history of the world: But, according to this same doctrine of the non-specialised, the hegemony of the civilised world a thousand years hence will not remain with this race, probably even not with any branch of the Teutonic stock, but will have fallen into very different hands, which it would be out of place here to indicate.

4. The last error of the orators and writers of "progress" is taken from a false analogy. They liken humanity, not to a growing tree, sending out branches in various directions, but to a traveller marching along a road, who must either come to a stand or go on in one given direction. That

direction is of course determined by the wishes or the whims of the speaker. If you do not fall in with his ideas and projects you are liable to be denounced as one who wishes to arrest progress, "already slow enough," and you are, in somewhat stale figures, likened to the Mrs. Partington of modern mythology. Yet perhaps that particular "progress" you seek to arrest may be but the rogue's march to the gallows, the sick man's approach to dissolution.

Such are some of the considerations which suggest themselves if we seek to apply the principles of Evolutionism—perhaps we had better say of "Transformism," inelegant as is the word—to a survey of the present position and future prospects of society and of societies. We would recommend social, moral, and political thinkers to familiarise themselves more thoroughly than they have hitherto done with these principles. Perhaps they may find occasion to reconsider certain of the dogmas in which they most delight.

VI. OUR ANIMAL ENEMIES AND ALLIES RECONSIDERED.

SCANTY as is the British fauna, our knowledge of its relation to human needs and conveniences is by no means complete. Almost every season we notice fresh features in the habits and character of some apparently well-known species which must be taken into account when the question of its preservation or destruction has to be raised. In such cases we cannot help asking whether our forefathers have merely omitted to record some old fact, or whether the species in question are developing new habits? On this point no general law can be laid down. We know that changes of diet have been distinctly traced, as in the New Zealand parrot and the South African baboon, both of which have quite recently acquired a taste for mutton. In like manner, if we turn over the zoological literature of the past, we find the common squirrel invariably spoken of as perfectly harmless, living upon nuts and acorns. Yet if we consult modern gardeners whose lot has been cast in well-wooded districts, or if, better still, we contrive to make observations in person in such a neighbourhood, we shall find cause to regard this elegant little animal as a tree-rat, meriting little toleration at our hands. He now varies his traditional diet with wall-fruit, and occasionally with pears and apples, carefully selecting the finest specimens. His depredations of this kind are not mere matter of conjecture; again and again, in the stillness of an early summer morning, he has been watched in the very act of gnawing peaches. The marks of his teeth in pears, &c., are also quite distinct from the peckings of birds.

But there is another charge against the squirrel: in shrubberies undisturbed by human depredators we may one day observe a bird sitting peacefully upon her eggs; the next day we find the nest all pulled to pieces, the eggs gone, and the parent-birds flown to seek some safer spot. This mischief is also due to the squirrel. Accordingly, if one of these buff-coloured rodents makes his appearance in a grove during nesting time, the alarm and dismay of the birds is almost as striking as if a hawk were seen hovering overhead or a weasel were running up the tree. Egg-eating appears to be distinctly one of the squirrel's modern accomplishments. Whether he confines his attacks to the nests of tree-haunting species, or occasionally indulges in a raid upon the eggs of the partridge and the pheasant, we cannot say with certainty. Still, from certain suspicious facts, we should commend him to the jealous scrutiny of the gamekeeper.

As far as the smaller birds are concerned, however, not merely the eggs but the callow young are exposed to the attacks of Bunny. Hence, for our part, we feel no hesitation in signing his general death-warrant.

But to find a means for carrying out the sentence is difficult. It is rarely possible to get a fair shot at him if he knows that you are in pursuit, as he dexterously contrives to keep the stem of a tree or a thick branch between himself and the source of danger. Sometimes in the twilight of a summer evening a family party of squirrels will come down to have a dance on the lawn, and may then be struck down if a loaded gun is at hand. In his early morning raids in the garden, too, he sometimes may be found within range in the open. Dogs and cats pursue him, but they are almost equally inefficient. We think, indeed, that a cat has more chance of catching a bird than a squirrel.

As for his wild enemies, the weasel and the polecat—which occasionally surprise him in his nest by night or in his winter-retreats—cannot be encouraged where poultry or game are being reared. The same objection applies to the carrion crow, the raven, and to certain hawks. The larger owls are probably his best and most trustworthy opponents, and should from a variety of grounds be preserved and encouraged. Much might be done towards the extirpation of the squirrel by careful search during the winter in the hollows of trees. How is it that no one has yet devised a squirrel-trap?

Passing from Mammalia to birds, we are sorry to find that not a few are far from improving on a closer acquaintance. The number of purely zoophagous species which do not admit more or less vegetable matter—seeds, fruits. &c.—into their dietary is not large. We may even ask whether among those birds which remain with us throughout the year there are, save the birds of prey, commonly so called, any purely zoophagous forms? In a severe winter the supply of insects, worms, slugs, &c., is often interrupted for so long a time that a bird incapable of digesting seeds, berries, &c., would be in great peril of starvation.

Among the more useful wild birds the starling has long held high rank as a vermin-destroyer. The German farmers from time immemorial have been in the habit of fixing up small boxes in their orchards, in which this bird may build its nest, secure from cats, hawks, owls, &c. We have often heard the opinion expressed, by intelligent and observant men, that the protection thus afforded to the starling was well remunerated. Nevertheless everyone must have seen this bird feasting upon the red currants in our gardens, and have heard it protest with angry screams when the fruit is being gathered and carried away.

The jay, as a member of the same group, the Corvidæ, by repute zoophagous, is for the most part denounced—mainly by game-preservers—as a suspected destroyer of the eggs of pheasants and partridges, and defended by lovers of birds as an eradicator of caterpillars and other noxious insect-larvæ. It may be, however, that his main disservices to man are to be witnessed in the orchard and the kitchen-garden rather than in the game-preserve. The skill with which he extracts peas and beans from the pod, leaving it apparently intact until it collapses on handling, is worth notice. The scarlet-runner and the kidney bean do not seem to meet his taste at any stage of their growth. Gooseberries the bird attacks in a similar style, making a small opening with the point of his beak, sucking out the pulp, and leaving the empty skin hanging. The jay is decidedly a neat feeder.

Whether his good deeds among cockchaffers, Elaters, and noxious larvæ fairly compensate his work among various crops is hard to decide.

The thrush group, as it has been often pointed out, hold also an ambiguous position. Did they merely take "a little fruit"—as certain writers euphemistically express it—they might live in our good graces. But where they are plentiful and have been fed through the winter they display their gratitude by taking "not some, but all." Long before the crop is ripe they make numerous trial borings, never finishing a fruit. The damage thus begun is carried on by wasps, flies, earwigs, &c., and by rain, and the fruit in consequence rots before it can ripen. Scarecrows, however cunningly devised, lose their terrors in at most three or four days. Nets are not easily applied to standard trees, and are in any case certain to keep off an appreciable portion of the sunshine, rarely too abundant in Britain.

Last and worst of the feathered race comes the sparrow. Not, indeed, that a particle of evidence has turned up in his favour. All the intelligence that comes to hand from countries where he has been indiscreetly acclimatised—*e.g.*, the United States—points in one and the same direction. Careful observers there have not merely watched closely the doings, the goings, and comings of the sparrow, but have from time to time shot a specimen, and opening his crop made an examination of its contents. The result has been most condemnatory: three-fourths at least of the food of the sparrow are in this manner proved to consist not of caterpillars, gnats, and the like, but of fruit, grain, and other matter which man preserves to reserve for his own consumption. We can pronounce this bird, therefore, frugivorous from choice and occasionally insectivorous from necessity, with a general tendency to mischief. Thus one observer, finding the sparrows apparently hard at work in some vines, left them for a time unmolested, in the belief that they were ridding the vines of some injurious insect. On closer examination he found that they were biting off the fruit-buds, eating, however, little of what they thus destroyed, but throwing the fragments to the ground in superfluity of naughtiness. The owner's prospect of a crop of grapes for the season was thus effectually cut off.

Another sin of the sparrow is manifested as strikingly in America as in Europe,—the war, too often successful, which it wages against the harmless and useful swallow. The helpless young swallows are often dragged from the nest and thrown to the ground, and the parent birds, on their return, find the hateful enemy in possession. We fear, from a variety of facts which come under our notice, that the swallow and the martin are becoming decidedly less abundant in Britain, and that this decrease is owing in great part to the increase of the sparrow. We know an instance of a mansion in Essex, standing in its own grounds of about 80 acres, where the swallows were till lately very numerous. They were considered by the proprietor and his family as most welcome visitants, since the neighbourhood is in summer much infested with gnats and midges. But though protected from all ordinary forms of molestation they have gradually become less and less numerous, and this year, if we remember rightly, none at all have put in an appearance. In former seasons it has repeatedly happened that their young brood has been thrown down by the sparrows, and more than once an intruding hen sparrow has suffered death on being caught in a swallow's nest.

Now if we remember that gnats are found to be not a mere irritation or annoyance, but conveyers of disease, the preservation of the swallow and of every gnat-destroyer becomes a point of sanitary policy, and is consequently a national concern. The question therefore arises whether a war of extirpation against the sparrow should not be undertaken in a more general and systematic manner than has heretofore been the case.

Turning from birds to Batrachians we find a shade of doubt attaching to the toad,—an animal which we have hitherto regarded as an unimpeachable friend. His services against slugs, wood-lice, and a number of garden-pests, are generally recognised. But we have heard it latterly asserted, by persons whose evidence is entitled to some respect, that he has been seen in the very act of devouring strawberries. We by no means consider the proof sufficient, and hope that our sober friend may yet be found entitled to an honourable acquittal. But we recommend close observation during the ensuing season. Nothing short of being seen in the very act ought to suffice, since a bitten strawberry may be, and generally is, the work of snails or slugs. All our knowledge, indeed, concerning the habits of the toad and his allies militates plainly against his proving to be a fruit-eater, but we have had abundant proof that the habits of animals often differ strikingly from what their structure and their affinities seem to warrant.

Concerning noisome and destructive insects there is this season but little to remark. The crane-fly, or daddy long-legs (*Tipula oleracea*), has been found in many parts of

England in almost unexampled numbers; so that, unless its eggs and larvæ meet with some destroying agent before the spring, there is every reason to fear that the grass and the corn must suffer heavily. The slaughter made among this enemy by birds, spiders, &c., seemed quite a vanishing quantity when compared with the millions remaining.

The house-fly has been in many places less abundant than usual. We have even met with persons ill-informed or injudicious enough to consider this scarcity an evil omen in a sanitary point of view.

The blowfly appears to have an especial fondness for ivy-blossom,—a tendency not easy to understand, since the ivy certainly gives off no odour at all similar to that of tainted meat.

Wasps have been locally plentiful, and very destructive to fruit. Their nests are now preferably attacked by means of petroleum. The exact position is marked in the daytime, and after nightfall the nest is drenched with half a gallon of petroleum, more or less according to size, and ignited either by means of a match or by firing a blank cartridge into the mass. This method is far safer and more efficient than the old methods of digging out, blowing up with gunpowder, &c. We now think that the extirpation of wasps may be undertaken with little scruple, since the chief service which they render, the destruction of blowflies, can be better effected by other methods. In the fertilisation of flowers wasps play but a very subordinate part.

Earwigs have been unusually scarce, as far as we have been able to observe, and the gooseberry caterpillar and moth (*Abraxas grossulariata*) has in many gardens been totally absent.

Altogether insects of all the orders have been exceptionally scarce,—a fact ascribed by some to the extremely damp character of the last winter, when many larvæ, and especially pupæ, must have become mouldy.

On recapitulating the above facts we cannot help seeing that the old absolute distinction made between the "carnivorous" and "herbivorous" animals is, like most such dualistic classifications, no longer tenable. With the great exception of the ruminant group, whose highly specialised digestive organs are adapted to deal with huge quantities of a sparingly nutritious matter, the majority of mammals are omnivorous, capable of adapting themselves either to an animal or a vegetable diet, or to a mixture of both. This conclusion is not merely fatal to one of the dogmas of the Old Natural History, but militates against the fundamental principles of the Vegetarian movement.

VII. A PLEA FOR PURE SCIENCE.*

By Prof. H. A. Rowland.†

THE question is sometimes asked us as to the time of year we like the best. To my mind the spring is the most delightful; for Nature then recovers from the apathy of winter, and stirs herself to renewed life. The leaves grow, and the buds open, with a suggestion of vigour delightful to behold, and we revel in this ever-renewed life of Nature. But this cannot always last. The leaves reach their limit; the buds open to the full, and pass away. Then we begin to ask ourselves whether all this display has been in vain, or whether it has led to a bountiful harvest.

So this magnificent country of ours has rivalled the vigour of spring in its growth. Forests have been levelled, and cities built, and a large and powerful nation has been created on the face of the earth. We are proud of our advancement. We are proud of such cities as this, founded in a day upon a spot over which, but a few years since, the red man hunted the buffalo. But we must remember that this is only the spring of our country. Our glance must not be backward; for however beautiful leaves and blossoms are, and however marvellous their rapid increase, they are but leaves and blossoms after all. Rather should we look forward to discover what will be the outcome of all this, and what the chance of harvest. For if we do this in time we may discover the worm which threatens the ripe fruit, or the barren spot where the harvest is withering for want of water.

I am required to address the so-called physical section of this Association. Fain would I speak pleasant words to you on this subject; fain would I recount to you the progress made in this subject by my countrymen, and their noble efforts to understand the order of the universe. But I go out to gather the grain ripe to the harvest, and I find only tares. Here and there a noble head of grain rises above the weeds; but so few are they that I find the majority of my countrymen know them not, but think that they have a waving harvest, while it is only one of weeds after all. American science is a thing of the future, and not of the present or past; and the proper course of one in my position is to consider what must be done to create a science of physics in this country, rather than to call telegraphs, electric lights, and such conveniences, by the name of Science. I do not wish to underrate the value of all these things; the progress of the world depends on them, and he is to be honoured who cultivates them successfully. So also the cook who invents a new and palatable dish for the table benefits the world to a certain degree; yet we do not dignify him by the name of a chemist. And yet it is not an uncommon thing, especially in American newspapers, to have the *applications* of Science confounded with Pure Science; and some obscure American who steals the ideas of some great mind of the past, and enriches himself by the application of the same to domestic uses, is often lauded above the great originator of the idea, who might have worked out hundreds of such applications had his mind possessed the necessary element of vulgarity. I have often been asked which was the more important to the world, pure or applied science? To have the applications of a science, the science itself must exist. Should we stop its progress, and attend only to its applications, we should soon degenerate into a people like the Chinese, who have made no progress for generations, because they have been satisfied with the applications of Science, and have never sought for reasons in what they have done. The reasons constitute Pure Science. They have known the application of gunpowder for centuries; and yet the reasons for its peculiar action, if sought in the proper manner, would have developed the science of chemistry, and even of physics, with all their numerous applications. By contenting themselves with the fact that gunpowder will explode, and seeking no farther, they have fallen behind in the progress of the world; and we now regard this oldest and most numerous of nations as only barbarians. And yet our own country is in the same state. But we have done better; for we have taken the science of the Old World and applied it to all our uses, accepting it like the rain of heaven, without asking whence it came, or even acknowledging the debt of gratitude we owe to the great and unselfish workers who have given it to us. And, like the rain of heaven, this Pure Science has fallen upon our country, and made it great and rich and strong.

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* In using the word "Science," I refer to physical science, as I know nothing of natural science. Probably my remarks will, however, apply to both, but I do not know.

† An Address delivered before Section B (Physics), American Association for the Advancement of Science. Minneapolis, 1883.

To a civilised nation of the present day the applications of Science are a necessity; and our country has hitherto succeeded in this line, only for the reason that there are certain countries in the world where Pure Science has been and is cultivated, and where the study of Nature is considered a noble pursuit. But such countries are rare, and those who wish to pursue Pure Science in our own country must be prepared to face public opinion in a manner which requires much moral courage. They must be prepared to be looked down upon by every successful inventor whose shallow mind imagines that the only pursuit of mankind is wealth, and that he who obtains most has best succeeded in this world. Everybody can comprehend a million of money; but how few can comprehend any advance in scientific theory, especially in its more abstruse portions! And this, I believe, is one of the causes of the small number of persons who have ever devoted themselves to work of the higher order in any human pursuit. Man is a gregarious animal, and depends very much for his happiness on the sympathy of those around him; and it is rare to find one with the courage to pursue his own ideals in spite of his surroundings. In times past men were more isolated than at present, and each came in contact with a fewer number of people. Hence that time constitutes the period when the great sculptures, paintings, and poems were produced. Each man's mind was comparatively free to follow its own ideals, and the results were the great and unique works of the ancient masters. To-day the railroad and the telegraph, the books and the newspapers, have united each individual man with the rest of the world; instead of his mind being an individual, a thing apart by itself, and unique, it has become so influenced by the outer world, and so dependent upon it, that it has lost its originality to a great extent. The man who in times past would naturally have been in the lowest depths of poverty, mentally and physically, to-day measures tape behind a counter, and with lordly air advises the naturally born genius how he may best bring his outward appearance down to a level with his own. A new idea he never had, but he can at least cover his mental nakedness with ideas imbibed from others. So the genius of the past soon perceives that his higher ideas are too high to be appreciated by the world; his mind is clipped down to the standard form; every natural offshoot upwards is repressed, until the man is no higher than his fellows. Hence the world, through the abundance of its intercourse, is reduced to a level. What was formerly a grand and magnificent landscape, with mountains ascending above the clouds, and depths whose gloom we cannot now appreciate, has become serene and peaceful. The depths have been filled, and the heights levelled, and the wavy harvests and smoky factories cover the landscape.

As far as the average man is concerned the change is for the better. The average life of man is far pleasanter, and his mental condition better, than before. But we miss the vigour imparted by the mountains. We are tired of mediocrity, the curse of our country. We are tired of seeing our artists reduced to hirelings, and imploring Congress to protect them against foreign competition. We are tired of seeing our countrymen take their science from abroad, and boast that they here convert it into wealth. We are tired of seeing our professors degrading their chairs by the pursuit of Applied Science instead of Pure Science, or sitting inactive while the whole world is open to investigation, lingering by the wayside while the problem of the universe remains unsolved. We wish for something higher and nobler in this country of mediocrity, for a mountain to relieve the landscape of its monotony. We are surrounded with mysteries, and have been created with minds to enjoy and reason to aid in the unfolding of such mysteries. Nature calls to us to study her, and our better feelings urge us in the same direction.

For generations there have been some few students of Science who have esteemed the study of Nature the most noble of pursuits. Some have been wealthy, and some poor; but they have all had one thing in common—the love of Nature and its laws. To these few men the world owes all the progress due to Applied Science, and yet very few ever received any payment in this world for their labours.

Faraday, the great discoverer of the principle on which all machines for electric lighting, electric railways, and the transmission of power must rest, died a poor man, although others and the whole world have been enriched by his discoveries. And such must be the fate of the followers in his footsteps for some time to come.

But there will be those in the future who will study Nature from pure love, and for them higher prizes than any yet obtained are waiting. We have but yet commenced our pursuit of Science, and stand upon the threshold wondering what there is within. We explain the motion of the planet by the law of gravitation; but who will explain how two bodies, millions of miles apart, tend to go toward each other with a certain force?

We now weigh and measure electricity and electric currents with as much ease as ordinary matter, yet have we made any approach to an explanation of the phenomenon of electricity? Light is an undulatory motion, and yet do we know what it is that undulates? Heat is motion, yet do we know what it is that moves? Ordinary matter is a common substance, and yet who shall fathom the mystery of its internal constitution?

There is room for all in the work, and the race has but commenced. The problems are not to be solved in a moment, but need the best work of the best minds, for an indefinite time.

Shall our country be contented to stand by, while other countries lead in the race? Shall we always grovel in the dust, and pick up the crumbs which fall from the rich man's table counting ourselves richer than he because we have more crumbs, while we forget that he has the cake, which is the source of all crumbs? Shall we be swine, to whom the corn and husks are of more value than the pearls? If I read aright the signs of the times, I think we shall not always be contented with our inferior position. From looking down we have almost become blind, but may recover. In a new country the necessities of life must be attended to first. The curse of Adam is upon us all, and we must earn our bread.

But it is the mission of Applied Science to render this easier for the whole world. There is a story which I once read which will illustrate the true position of Applied Science in the world:—A boy, more fond of reading than of work, was employed, in the early days of the steam-engine, to turn the valve at every stroke. Necessity was the mother of invention in his case: his reading was disturbed by his work, and he soon discovered that he might become free from his work by so tying the valve to some movable portion of the engine as to make it move its own valve. So I consider that the true pursuit of mankind is intellectual. The scientific study of Nature in all its branches, of mathematics, of mankind in its past and present, the pursuit of art, and the cultivation of all that is great and noble in the world—these are the highest occupation of mankind. Commerce, the applications of Science, the accumulation of wealth, are necessities which are a curse to those with high ideals, but a blessing to that portion of the world which has neither the ability nor the taste for higher pursuits.

As the applications of Science multiply, living becomes easier, the wealth necessary for the purchase of apparatus can better be obtained, and the pursuit of other things besides the necessities of life becomes possible.

But the moral qualities must also be cultivated in proportion to the wealth of the country, before much can be done in Pure Science. The successful sculptor or painter naturally attains to wealth through the legitimate work of his profession. The novelist, the poet, the musician, all have wealth before them as the end of a successful career. But the scientist and the mathematician have no such incentive to work: they must earn their living by other pursuits, usually teaching, and only devote their surplus time to the true pursuit of their science. And frequently, by the small salary which they receive, by the lack of instrumental and literary facilities, by the mental atmosphere in which they exist, and most of all, by their low ideals of life, they are led to devote their surplus time to Applied Science or to other means of increasing their fortune. How shall we, then, honour the few, the very few, who, in spite of all difficulties, have kept their eyes fixed on the goal, and have steadily worked for Pure Science, giving to the world a most precious donation, which has borne fruit in our greater knowledge of the universe and in the applications to our physical life which have enriched thousands and benefitted each one of us? There are also those who have every facility for the pursuit of Science, who have an ample salary and every appliance for works, yet who devote themselves to commercial work, to testifying in courts of law, and to any other work to increase their present large income. Such men would be respectable if they gave up the name of professor, and took that of consulting chemists or physicists. And such men are needed in the community. But for a man to occupy the professor's chair in a prominent college, and, by his energy and ability in the commercial applications of his science, stand before the local community in a prominent manner, and become the newspaper exponent of his science, is a disgrace both to him and his college. It is the death-blow to Science in that region. Call him by his proper name, and he becomes at once a useful member of the community. Put in his place a man who shall by precept and example cultivate his science, and how different is the result! Young men looking forward into the world for something to do, see before them this high and noble life, and they see that there is something more honourable than the accumulation of wealth. They are thus led to devote their lives to similar pursuits, and they honour the professor who has drawn them to something higher than they might otherwise have aspired to reach.

I do not wish to be misunderstood in this matter. It is no disgrace to make money by an invention, or otherwise, or to do commercial scientific work under some circumstances. But let Pure Science be the aim of those in the chairs of professors, and so prominently the aim that there can be no mistake. If our aim in life is wealth, let us honestly engage in commercial pursuits, and compete with others for its possession. But if we choose a life which we consider higher, let us live up to it, taking wealth or poverty as it may chance to come to us, but letting neither turn us aside from our pursuit.

The work or teaching may absorb the energies of many; and, indeed, this is the excuse given by most for not doing any scientific work. But there is an old saying, that where there is a will there is a way. Few professors do as much teaching or lecturing as the German professors, who are also noted for their elaborate papers in the scientific journals. I myself have been burdened down with work, and know what it is; and yet I here assert that all *can* find time for scientific research if they desire it. But here, again, that curse of our country, mediocrity, is upon us. Our colleges and universities seldom call for first-class men of reputation, and I have even heard the trustee of a well-known college assert that no professor should engage in research because of the time wasted! I was glad to see, soon after, by the call of a prominent scientist to that college, that the majority of the trustees did not agree with him.

That teaching is important, goes without saying. A successful teacher is to be respected; but if he does not lead his scholars to that which is the highest, is he not blameworthy? We are, then, to look to the colleges and universities of the land for most of the work in Pure Science which is done. Let us therefore examine these latter, and see what the prospect is.

One, whom perhaps we may here style a practical follower of Ruskin, has stated that while in this country he was variously designated by the title of captain, colonel, and professor. The story may or may not be true, but we all know enough of the customs of our countrymen not to dispute it on general principles. All men are born equal: some men are captains, colonels, and professors, and therefore all men are such. The logic is conclusive; and the same kind of logic seems to have been applied to our schools, colleges, and universities. I have before me the report of the commissioner of education for 1880. According to that report, there were 389,* or say, in round numbers, 400 institutions, calling themselves colleges or universities, in our country! We may well exclaim that ours is a great country, having more than the whole world beside. The fact is sufficient. The whole earth would hardly support such a number of first-class institutions. The curse of mediocrity must be upon them, to swarm in such numbers. They must be a cloud of mosquitoes, instead of eagles as they profess. And this becomes evident on further analysis. About one-third aspire to the name of university; and I note one called by that name which has two professors and 18 students, and another having three teachers and 12 students! And these instances are not unique, for the number of small institutions and schools which call themselves universities is very great. It is difficult to decide from the statistics alone the exact standing of these institutions. The extremes are easy to manage. Who can doubt that an institution with over 800 students, and a faculty of 70, is of a higher grade than those above cited having 10 or 20 students and two or three in the faculty? Yet this is not always true; for I note one institution with over 500 students which is known to me personally as of the grade of a high school. The statistics are more or less defective, and it would much weaken the force of my remarks if I went too much into detail. I append the following tables, however, of 330 so-called colleges and universities:—

218	had	from	0	to	100	students.
88	,,	,,	100	,,	200	,,
12	,,	,,	200	,,	300	,,
6	,,	,,	300	,,	500	,,
6	over		500			,,

Of 322 so-called colleges and universities:—

206	had	0 to 10	in the	faculty.
99	,,	10 ,, 20	,,	,,
17	,,	20 or over	,,	,,

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* 364 reported on, and 25 not reported.

If the statistics were forthcoming—and possibly they may exist—we might also get an idea of the standing of these institutions and their approach to the true university idea, by the average age of the scholars. Possibly also the ratio of number of scholars to teachers might be of some help. All these methods give an approximation to the present standing of the institutions. But there is another method of attacking the problem, which is very exact, but it only gives us the *possibilities* of which the institution is capable. I refer to the wealth of the institution. In estimating the wealth, I have not included the value of grounds and buildings, for this is of little importance, either to the present or future standing of the institution. As good work can be done in a hovel as in a palace. I have taken the productive funds of the institution as the basis of estimate. I find :—

234 have below 500,000 dols.
8 ,, between 500,000 and 1,000,000 dols.
8 ,, over 1,000,000.

There is no fact more firmly established, all over the world, than that the higher education can never be made to pay for itself. Usually the cost to a college, of educating a young man, very much exceeds what he pays for it, and is often three or four times as much. The higher the education, the greater this proportion will be; and a university of the highest class should anticipate only a small accession to its income from the fees of students. Hence the test I have applied must give a true representation of the possibilities in every case. According to the figures, only 16 colleges and universities have 500,000 dols. or over of invested funds, and only one-half of these have 1,000,000 dols. and over. Now, even the latter sum is a very small endowment for a college; and to call any institution a university which has less than 1,000,000 dols., is to render it absurd in the face of the world. And yet more than 100 of our institutions, many of them very respectable colleges, have abused the word " university " in this manner. It is to be hoped that the endowment of the more respectable of these institutions may be increased, as many of them deserve it; and their unfortunate appellation has probably been repented of long since.

But what shall we think of a community that gives the charter of a university to an institution with a total of 20,000 dols. endowment, two so-called professors, and 18 students? or another with three professors, 12 students, and a total of 27,000 dols. endowment, mostly invested in buildings! And yet there are very many similar institutions; there being 16 with three professors or less, and very many indeed with only four or five.

Such facts as these could only exist in a democratic country, where pride is taken in reducing everything to a level. And I may also say that it can only exist in the early days of such a democracy; for an intelligent public will soon perceive that calling a thing by a wrong name does not change its character, and that truth, above all things, should be taught to the youth of the nation.

It may be urged that all these institutions are doing good work in education; and that many young men are thus taught, who could not afford to go to a true college or university. But I do not object to the education,—though I have no doubt an investigation would disclose equal absurdities here,—for it is aside from my object. But I do object to lowering the ideals of the youth of the country. Let them know that they are attending a school, and not a university; and let them know that above them comes the college, and above that the university. Let them be taught that they are only half educated, and that there are persons in the world by whose side they are but atoms. In other words, let them be taught the truth.

It may be that some small institutions are of high grade, especially those which are new; but who can doubt that more than two-thirds of our institutions calling themselves colleges and universities are unworthy of the name? Each one of these institutions has so-called professors, but it is evident that they can be only of the grade of teachers. Why should they not be so called? The position of teacher is an honoured one, but is not made more honourable by the assumption of a false title. Furthermore, the multiplication of the title, and the ease with which it can be obtained, render it scarcely worth striving for. When the man of energy, ability, and perhaps genius is rewarded by the same title and emoluments as the commonplace man with the modicum of knowledge, who takes to teaching, not because of any aptitude for his work, but possibly because he has not the energy to compete with his fellow-men in business, then I say one of the inducements for first-class men to become professors is gone.

When work and ability are required for the position, and when the professor is expected to keep up with the progress of his subject, and to do all in his power to advance it, and when he is selected for these reasons, then the position will be worth working for, and the successful competitor will be honoured accordingly. The chivalric spirit which prompted Faraday to devote his life to the study of nature may actuate a few noble men to give their life to scientific work; but, if we wish to cultivate this highest class of men in science, we must open a career for them worthy of their efforts.

Jenny Lind, with her beautiful voice, would have cultivated it to some extent in her native village; yet who would expect her to travel over the world, and give concerts for nothing? and how would she have been able to do so if she had wished? And so the scientific man, whatever his natural talents, must have instruments and a library, and a suitable and respectable salary to live upon, before he is able to exert himself to his full capacity. This is true of advance in all the higher departments of human learning, and yet something more is necessary. It is not those in this country who receive the largest salary, and have positions in the richest colleges, who have advanced their subject the most: men receiving the highest salaries, and occupying the professor's chair, are to-day doing absolutely nothing in Pure Science, but are striving by the commercial applications of their science to increase their already large salary. Such pursuits, as I have said before, are honourable in their proper place; but the duty of a professor is to advance his science, and to set an example of pure and true devotion to it which shall demonstrate to his students and the world that there is something high and noble worth living for. Money-changers are often respectable men, and yet they were once severely rebuked for carrying on their trade in the court of the Temple.

Wealth does not constitute a university, buildings do not: it is the men who constitute its faculty, and the students who learn from them. It is the last and highest step which the mere student takes. He goes forth into the world, and the height to which he rises has been influenced by the ideals which he has consciously or unconsciously imbibed in his university. If the professors under whom he has studied have been high in their profession, and have themselves had high ideals; if they have considered the advance of their particular subject their highest work in life, and are themselves honoured for their intellect throughout the world, —the student is drawn toward that which is highest, and ever after in life has high ideals. But if the student is taught by what are sometimes called good teachers, and teachers only, who know little more than the student, and who are often surpassed and even despised by him, no one can doubt the lowered tone of his mind. He finds that by his feeble efforts he can surpass one to whom a university has given its highest honour; and he begins to think that he himself is a born genius, and the incentive to work is gone. He is great by the side of the molehill, and does not know any mountain to compare himself with.

A university should not only have great men in its faculty, but have numerous minor professors and assistants of all kinds, and should encourage the highest work, if for no other reason than to encourage the student to his highest efforts.

But, assuming that the professor has high ideals, wealth such as only a large and high university can command is necessary to allow him the fullest development.

And this is specially so in our science of physics. In the early days of physics and chemistry, many of the fundamental experiments could be performed with the simplest apparatus. And so we often find the names of Wollaston and Faraday mentioned as needing scarcely anything for their researches. Much can even now be done with the simplest apparatus; and nobody, except the utterly incompetent, need stop for want of it. But the fact remains, that one can only be free to investigate in all departments of chemistry and physics, when he not only has a complete laboratory at his command, but a friend to draw on for the expenses of each experiment. That simplest of the departments of physics, namely, astronomy, has now reached such perfection that nobody can expect to do much more in it without a perfectly equipped observatory; and even this would be useless without an income sufficient to employ a corps of assistants to make the observations and computations. But even in this simplest of physical subjects, there is great misunderstanding. Our country has very many excellent observatories: and yet little work is done in comparison, because no provision has been made for maintaining the work of the observatory; and the wealth which, if concentrated, might have made one effective observatory which would prove a benefit to astronomical science, when scattered among a half-dozen, merely furnishes telescopes for the people in the surrounding region to view the moon with. And here I strike the keynote of at least one need of our country, if she would stand well in Science; and the following item, which I clip from a newspaper, will illustrate the matter:—

"The eccentric old Canadian, Arunah Huntington, who left 200,000 dols. to be divided among the public scools of Vermont, has done something which will be of little practical value to the schools. Each district will be entitled to the insignificant sum of 10 dols., which will not advance much the cause of education."

Nobody will dispute the folly of such a bequest, or the folly of filling the country with telescopes to look at the moon, and calling them observatories. How much better to concentrate the wealth into a few parcels, and make first-class observatories and institutions with it!

Is it possible that any of our four hundred colleges and universities have love enough of learning to unite with each other and form larger institutions? Is it possible that any have such a love of truth that they are willing to be called by their right name? I fear not; for the spirit of expectation, which is analogous to the spirit of gambling, is strong in the American breast, and each institution which now, except in name, slumbers in obscurity, expects in time to bloom out into full prosperity. Although many of them are under religious influence, where truth is inculcated, and where men are taught to take a low seat at the table in order that they may be honoured by being called up higher, and not dishonoured by being thrust down lower, yet these institutions have thrust themselves into the highest seats, and cannot probably be dislodged.

But would it not be possible to so change public opinion that no college could be founded with a less endowment than say 1,000,000, or no university with less than three or four times that amount? From the report of the Commissioner of Education, I learn that such a change is taking place; that the tendency towards large institutions is increasing, and that it is principally in the west and south-west that the multiplication of small institutions with big names is to be feared most, and that the east is almost ready for the great coming university.

The total wealth of the four hundred colleges and universities in 1880 was about 40,000,000 dols. in buildings, and 43,000,000 dols. in productive funds. This would be sufficient for one great university of 10,000,000 dols., four of 5,000,000 dols., and twenty-six colleges of 2,000,000 dols. each. But such an idea can of course never be carried out. Government appropriations are out of the question, because no political trickery must be allowed around the ideal institution.

In the year 1880 the private bequests to all schools and colleges amounted to about 5,500,000 dols.; and, although there was one bequest of 1,250,000 dols., yet the amount does not appear to be phenomenal. It would thus seem that the total amount was about 5,000,000 dols. in one year, of which more than half is given to so-called colleges and universities. It would be very difficult to regulate these bequests so that they might be concentrated sufficiently to produce an immediate result. But the figures show that generosity is a prominent feature of the American people, and that the needs of the country only have to be appreciated to have the funds forthcoming. We must make the need of research and of Pure Science felt in the country. We must live such lives of pure devotion to our Science, that all shall see that we ask for money, not that we may live in indolent ease at the expense of charity, but that we may work for that which has advanced and will advance the world more than any other subject, both intellectually and physically. We must live such lives as to neutralise the influence of those who in high places have degraded their profession, or have given themselves over to ease, and do nothing for the science which they represent. Let us do what we can with the present means at our disposal. There is not one of us who is situated in the position best adapted to bring out all his powers, and to allow him to do most for his science. All have their difficulties, and I do not think that circumstances will ever radically change a man. If a man has the instinct of research in him, it will always show itself in some form. But circumstances may direct it into new paths, or may foster it so that what would otherwise have died as a bud now blossoms and ripens into the perfect fruit.

Americans have shown no lack of invention in small things; and the same spirit, when united to knowledge and love of Science, becomes the spirit of research. The telegraph operator, with his limited knowledge of electricity and its laws, naturally turns his attention to the improvement of the only electrical instrument he knows anything about; and his researches would be confined to the limited sphere of his knowledge, and to the simple laws with which he is acquainted. But as his knowledge increases, and the field broadens before him, as he studies the mathematical theory of the subject, and the electro-magnetic theory of light loses the dim haze due to distance, and becomes his constant companion, the telegraph instrument becomes to him a toy, and his effort to discover something new becomes research in Pure Science.

It is useless to attempt to advance Science until one has mastered the science; he must step to the front before his blows can tell in the strife. Furthermore, I do not believe anybody can be thorough in any department of Science, without wishing to advance it. In the study of what is known, in the reading of the scientific journals, and the discussions therein contained of the current scientific questions, one would obtain an impulse to work, even though it did not before exist. And the same spirit which prompted him to seek what was already known, would make him wish to know the unknown. And I may say that I never met a case of thorough knowledge in my own science, except in the case of well-known investigators. I have met men who talked well, and I have sometimes asked myself why they did not do something; but further knowledge of their character has shown me the superficialty of their knowledge. I am no longer a believer in men who could do something if they would, or would do something if they had a chance. They are impostors. If the true spirit is there, it will show itself in spite of circumstances.

As I remarked before, the investigator in Pure Science is usually a professor. He must teach as well as investigate. It is a question which has been discussed in late years, as to whether these two functions would better be combined in the same individual, or separated. It seems to be the opinion of most, that a certain amount of teaching is conducive, rather than otherwise, to the spirit of research. I myself think that this is true, and I should myself not like to give up my daily lecture. But one must not be overburdened. I suppose that the true solution, in many cases, would be found in the multiplication of assistants, not only for the work of teaching, but of research. Some men are gifted with more ideas than they can work out with their own hands, and the world is losing much by not supplying them with extra hands. Life is short; old age comes quickly, and the amount one pair of hands can do is very limited. What sort of shop would that be, or what sort of factory, where one man had to do all the work with his own hands? It is a fact in nature, which no democracy can change, that men are *not* equal—that some have brains, and some hands. And no idle talk about equality can ever subvert the order of the universe.

I know of no institution in this country where assistants are supplied to aid directly in research. Yet why should it not be so? And even the absence of assistant professors and assistants of all kinds, to aid in teaching, is very noticeable, and must be remedied before we can expect much.

There are many physical problems, especially those requiring exact measurements, which cannot be carried out by one man, and can only be successfully attacked by the most elaborate apparatus, and with a full corps of assistants. Such are Regnault's experiments on the fundamental laws of gases and vapours, made thirty or forty years ago by aid from the French Government, and which are the standards to this day. Although these experiments were made with a view to the practical calculation of the steam-engine, yet they were carried out in such a broad spirit that they have been of the greatest theoretical use. Again, what would astronomy have done without the endowments of observatories? By their means, that science has become the most perfect of all branches of physics, as it should be from its simplicity. There is no doubt, in my mind, that similar institutions for other branches of physics, or, better, to include the whole of physics, would be equally successful. A large and perfectly equipped physical laboratory with its large revenues, its corps of professors and assistants, and its machine shop for the construction of new apparatus, would be able to advance our science quite as much as endowed observatories have astronomy. But such a laboratory should not be founded rashly. The value will depend entirely on the physicist at its head, who has to devise the plan, and to start it into practical working. Such a man will always be rare, and cannot always be obtained. After one had been successfully started, others could follow; for imitation requires little brains.

One could not be certain of getting the proper man every time, but the means of appointment should be most carefully studied so as to secure a good average. There can be no doubt that the appointment should rest with a scientific body capable of judging the highest work of each candidate.

Should any popular element enter, the person chosen would be either of the literary-scientific order, or the dabbler on the outskirts who presents his small discoveries in the most theatrical manner. What is required is a man of depth, who has such an insight into physical science that he can tell when blows will best tell for its advancement.

Such a grand laboratory as I describe does not exist in the world, at present, for the study of physics. But no trouble has ever been found in obtaining means to endow astronomical science. Everybody can appreciate, to some extent, the value of an observatory; as astronomy is the simplest of scientific subjects, and has very quickly reached a position where elaborate instruments and costly computations are necessary to further advance. The whole domain of physics is so wide that workers have hitherto found enough to do. But it cannot always be so, and the time has even now arrived when such a grand laboratory should be founded. Shall our country take the lead in this matter, or shall we wait for foreign countries to go before? They will be built in the future, but when and how is the question.

Several institutions are now putting up laboratories for physics. They are mostly for teaching, and we can expect only a comparatively small amount of work from most of them. But they show progress; and, if the progress be as quick in this direction as in others, we should be able to see a great change before the end of our lives.

As stated before, men are influenced by the sympathy of those with whom they come in contact. It is impossible to immediately change public opinion in our favour; and, indeed, we must always seek to lead it, and not be guided by it. For Pure Science is the pioneer who must not hover about cities and civilised countries, but must strike into unknown forests, and climb the hitherto inaccessible mountains which lead to and command a view of the promised land,—the land which Science promises us in the future; which shall not only flow with milk and honey, but shall give us a better and more glorious idea of this wonderful universe. We must create a public opinion in our favour, but it need not at first be the general public. We must be contented to stand aside, and see the honours of the world for a time given to our inferiors; and must be better contented with the approval of our own consciences, and of the very few who are capable of judging our work, than of the whole world beside. Let us look to the other physicists, not in our own town, not in our own country, but in the whole world, for the words of praise which are to encourage us, or the words of blame which are to stimulate us to renewed effort. For what to us is the praise of the ignorant? Let us join together in the bonds of our scientific societies, and encourage each other, as we are now doing, in the pursuit of our favourite study; knowing that the world will some time recognise our services, and knowing, also, that we constitute the most important element in human progress.

But danger is also near, even in our societies. When the average tone of the societies is low, when the highest honours are given to the mediocre, when third-class men are held up as examples, and when trifling inventions are magnified into scientific discoveries, then the influence of such societies is prejudicial. A young scientist attending the meetings of such a society soon gets perverted ideas. To his mind a molehill is a mountain, and the mountain a molehill. The small inventor or the local celebrity rises to a greater height, in his mind, than the great leader of Science in some foreign land. He gauges himself by the molehill, and is satisfied with his stature, not knowing that he is but an atom in comparison with the mountain, until, perhaps, in old age, when it is too late. But if the size of the mountain had been seen at first, the young scientist would at least have been stimulated in his endeavour to grow.

We cannot all be men of genius; but we can, at least, point them out to those around us. We may not be able to benefit Science much ourselves; but we can have high ideals on the subject, and instil them into those with whom we come in contact. For the good of ourselves, for the good of our country, for the good to the world, it is incumbent on us to form a true estimate of the worth and standing of persons and things, and to set before our own minds all that is great and good and noble, all that is most important for scientific advance, above the mean and low and unimportant.

It is very often said that a man has a right to his opinion. This might be true for a man on a desert island, whose error would influence only himself. But when he opens his lips to instruct others, or even when he signifies his opinions by his daily life, then he is directly responsible for all his errors of judgment or fact. He has no right to think a molehill as big as a mountain, nor to teach it, any more than he has to think the world flat, and teach that it is so. The facts and laws of our science have *not* equal importance, neither have the men who cultivate the science achieved equal results. One thing is greater than another, and we have no right to neglect the order. Thus shall our minds be guided aright, and our efforts be toward that which is the highest.

Then shall we see that no physicist of the first class has ever existed in this country, that we must look to other countries for our leaders in that subject, and that the few excellent workers in our country must receive many accessions from without before they can constitute an American science, or do their share in the world's work.

But let me return to the subject of scientific societies. Here American science has its hardest problem to contend with. There are very many local societies dignified by high-sounding names, each having its local celebrity, to whom the privilege of describing some crab with an extra claw, which he found in his morning ramble, is inestimable. And there are some academies of science, situated at our seats of learning, which are doing good work in their locality. But distances are so great that it is difficult to collect men together at any one point. The American Association, which we are now attending, is not a scientific academy, and does not profess to be more than a gathering of all who are interested in Science, to read papers and enjoy social intercourse. The National Academy of Sciences contains eminent men from the whole country, but then it is only for the purpose of advising the Government freely on scientific matters. It has no building, it has no library, and it publishes nothing except the information which it freely gives to the Government, which does nothing for it in return. It has not had much effect directly on American science; but the liberality of the Government in the way of scientific expeditions, publications, &c., is at least partly due to its influence, and in this way it has done much good. But it in no way takes the place of the great Royal Society, or the great Academies of Science at Paris, Berlin, Vienna, St. Petersburg, Munich, and indeed all the European capitals and large cities. These, by their publications, give to the young student, as well as the more advanced physicist, models of all that is considered excellent; and to become a member is one of the highest honours to which he can aspire, while to write a memoir which the Academy considers worthy to be published in its Transactions excites each one to his highest effort.

The American Academy of Sciences in Boston is perhaps our nearest representation of this class of academies, but its limitation of membership to the State deprives it of its national character.

But there is another matter which influences the growth of our science.

As it is necessary for us still to look abroad for our highest inspiration in Pure Science, and as Science is not an affair of one town or of one country, but of the whole world, it becomes us all to read the current Journals of Science and the great Transactions of foreign societies, as well as those of our own countries. These great Transactions and Journals should be in the library of every Institution of learning in the country where Science is taught. How can teachers and professors be expected to know what has been discovered in the past, or is being discovered now, if these are not provided? Has any Institution a right to mentally starve the teachers whom it employs, or the students who come to it? There can be but one answer to this; and an Institution calling itself a University, and not having the current scientific Journals upon its table, or the Transactions of Societies upon its library-shelves, is certainly not doing its best to cultivate all that is best in this world, We call this a free country, and yet it is the only one where there is a direct tax upon the pursuit of Science. The low state of Pure Science in our country may possibly be attributed to the youth of the country; but a direct tax, to prevent the growth of our country in that subject, cannot be looked upon as other than a deep disgrace. I refer to the duty upon foreign books and periodicals. In our science no books above elementary ones have ever been published, or are likely to be published, in this country; and yet every teacher in physics must have them, not only in the college library; but on his own shelves, and must pay the Government of this country to allow him to use a portion of his small salary to buy that which is to do good to the whole country. All freedom of intercourse which is necessary to foster our growing science is thus broken off, and that which might in time relieve our country of its mediocrity is nipped in the bud by our Government, which is most liberal when appealed to directly on scientific subjects.

One would think that books in foreign languages might be admitted free; but to please the half-dozen or so workmen who reprint German books, not scientific, our free intercourse with that country is cut off. Our scientific associations and societies must make themselves heard in this matter, and show those in authority how the matter stands.

In conclusion, let me say once more that I do not believe that our country is to remain long in its present position. The science of physics, in whose applications our country glories, is to arise among us, and make us respected by the nations of the world. Such a prophecy may seem rash with regard to a nation which does not yet do enough physical work to support a physical journal. But we know the speed with which we advance in this country: we see cities springing up in a night, and other wonders performed at an unprecedented rate. And now we see physical laboratories being built; we see a great demand for thoroughly trained physicists, who have not shirked their mathematics, both as professors and in so-called practical life; and perhaps we have the feeling common to all true Americans, that our country is going forward to a glorious future, when we shall lead the world in the strife for intellectual prizes as we now do in the strife for wealth.

But if this is to be so, we must now aim low. The problems of the universe cannot be solved without labour; they cannot be attacked without the proper intellectual as well as physical tools, and no physicist need expect to go far without his mathematics. No one expects a horse to win in a great and long race who has not been properly trained; and it would be folly to attempt to win with one, however pure his blood and high his pedigree, without it. The problems we solve are more difficult than any race: the highest intellect cannot hope to succeed without proper preparation. The great prizes are reserved for the greatest efforts of the greatest intellects, who have kept their mental eye bright and flesh hard by constant exercise. Apparatus can be bought with money, talents may come to us at birth; but our mental tools, our mathematics, our experimental ability, our knowledge of what others have done before us, all have to be obtained by work. The time is almost past, even in our own country, when third-rate men can find a place as teachers, because they are unfit for everything else. We wish to see brains and learning, combined with energy and immense working-power, in the professor's chair; but, above all, we wish to see that high and chivalrous spirit which causes one to pursue his idea in spite of all difficulties,—to work at the problems of Nature with the approval of his own conscience, and not of men before him. Let him fit himself for the struggle with all the weapons which mathematics and the experience of those gone before him can furnish, and let him enter the arena with the fixed and stern purpose to conquer. Let him not be contented to stand back with the crowd of mediocrity, but let him press forward for a front place in the strife.

The whole universe is before us to study. The greatest labour of the greatest minds has only given us a few pearls; and yet the limitless ocean, with its hidden depths filled with diamonds and precious stones, is before us. The problem of the universe is yet unsolved, and the mystery involved in one single atom yet eludes us. The field of research only opens wider and wider as we advance, and our minds are lost in wonder and astonishment at the grandeur and beauty unfolded before us. Shall we help in this grand work, or not? Shall our country do its share, or shall it still live in the almshouse of the world?

ANALYSES OF BOOKS.

Harmonies of Tones and Colours developed by Evolution. By F. J. Hughes. London: Marcus Ward and Co.

Most of our readers must be aware that to certain persons there is a distinct connection between tone and colour. To them, as we are told, the hearing of a tone suggests or calls up the impression of a colour, and the sight of a colour in an analogous manner conveys the sensation of a tone. All this, indeed, is something which lies entirely outside the bounds of our personal experience. Still we feel no right to deny such statements, lest we might fall into the error, *e.g.*, of a colour-blind person who should doubt the diversity of shades in the spectrum. The author of the work before us—who, by the way, is a second cousin of Charles Darwin—does not lay claim to the possession of this natural perception of the connection between tones and colours, but by studying the harmonies of both he has reached certain most interesting conclusions. We must, however, admit at the outset that the subject is involved in difficulties. Concerning colour—a matter which we have approached from the double point of view of the student of organic nature, and that of the tinctorial chemist—we may at any rate claim a little knowledge. But of acoustics, and still more decidedly of harmony, we know absolutely nothing, and to us, therefore, this work is as if in great part written in some unknown tongue.

The author maintains that "the fountain or life of musical harmonies and colours is E, or yellow; the root B, or ultra-violet; these being, in fact, tints and shades of white and black. Ascending they partake more of white; descending, of black; the former drawing tones and colours higher, the latter lower. Throughout the scheme seven tones and seven colours develop in every harmony. In the relationship between tones and colours the seven may be condensed into a pair: as an example we trace the notes and colours in the fundamental scale of C. C rises from the fountain, and contains all tones within itself. *Red* also rises from the fountain, and contains all colours, with white and black. D = the notes C and E mingled; *Orange*, red and yellow mingled. E, the root of the fountain. *Yellow*, containing all colours, is white in its extreme. F = the notes E and G mingled. *Green* = yellow and blue mingled. G contains all tones. *Blue*, with more or less of black and white. A = G and B mingled. *Violet* = blue and all colours inclining to black. B, the key-note of the fountain. *Ultra-violet* = violet mingled with more black, a deeper shade of all colours—in its extreme black."

In this parallelism of notes and colours we do not find the clearness which would be desirable. Red, yellow, and blue, if we understand Mr. Hughes aright, contain each all colours. We should like to see some experimental proof of this proposition. As far as research has gone, true red—the red of the spectrum—is what might be called a chromatic element from which nothing but red can be eliminated, although it may be blended with other colours to form compound shades. As regards yellow and blue, which the author classes along with red as "the three great apparent primaries," their elementary or simple character is not generally recognised. Indeed Mr. Hughes refers to Clerk Maxwell's proof that red and green in right proportions produce yellow. Violet the author likens to "blue and all colours inclining to black." To our eye a true violet might rather seem blue inclining to red. On the other hand, blue colours are now actually produced in the arts by mixtures of green and violet, a result which has only become possible since colours of a very high degree of purity have been obtainable.

Again, we do not distinctly see the meaning to be conveyed by the words "yellow, containing all colours is white in its extreme;" and again, "although yellow, as a colour, is explained away as white, it is nevertheless the colour yellow in endless tints and shades throughout Nature." Frankly speaking we do not know what the "extreme" of yellow is. If we seek such an "extreme" we pass into green on the one hand, and into orange on the other. If we take a yellow solution—*e.g.*, that of potassium dichromate—and dilute it with more and more distilled water, we get at last a colourless liquid. But we get the very same result by similarly diluting a solution of methyl-green or of eosine. When the author, however, puts yellow = E as the root of the fountain he seems to us to convey a truth which has been arrived at by other enquirers in a totally different manner. Yellow appears, in the evolution of plants and animals, to be the lowest stage of colouration, which Nature produces most readily, and at which she often stops short.

Those of our readers who wish to pursue this interesting and most difficult subject will do well to re-read an article on "Light and Sound," by Prof. W. F. Barrett, which appeared in the "Quarterly Journal of Science" for January, 1870, and which Mr. Hughes here quotes. This eminent physicist also assumes the note C to correspond to the colour red, finds D correspond to orange, E to yellow, and F to green.

Mr. Hughes says:—"The twelve notes, scales, and chords in the major and minor series, &c., all agree so exactly in their mode of development that if a piece of music is written correctly in colours, with their intermediate tints and shades, the experienced musician can, as a rule, detect errors more quickly and surely with the eye than with the ear." We much regret that we are unable to understand the diagrams—music printed partly in colours—in which the author seeks to demonstrate his views.

The Natural Genesis: or, Second Part of a Book of the Beginnings, containing an Attempt to Recover and Re-constitute the Lost Origins of the Myths and Mysteries, Types and Symbols, Religion and Language, with Egypt for the Mouthpiece and Africa as the Birthplace. By GERALD MASSEY. Vol. II. London: Williams and Norgate.

IN our issue for July of the present year we had the pleasure of giving a notice of the first volume of this extraordinary work. We could do no other than recognise its importance as the first systematic attempt to throw the light of Evolution into regions where it has been hitherto ignored, if not systematically rejected. At the same time we cannot help feeling that Mr. Massey runs some danger, to use an old proverb, of falling to the ground between two stools. On the one hand, the men who best understand and value Evolution, such as embryologists, taxonomists, and palæontologists, will be apt to turn away from the contemplation of myths and mysteries as something totally outside the sphere of their researches and studies. On the other hand, the mythologists, the students of primæval history, religions, and languages, regarding for the most part man as a being who has not risen from an original bestial condition, will be apt to give the author's views only a very scanty and superficial examination. We would venture a word of remonstrance with both parties. The naturalist claims, and must claim, anthropology as a part of his legitimate subject, and should therefore not overlook a work which so distinctly asserts and establishes this his claim. Again, the archæologist, the historian, and the philologist, if their object be really the discovery of truth, should not shrink back in horror at finding the facts of their respective sciences or eruditions set before them from a novel point of view.

The present volume treats, in successive chapters, of the natural genesis and typology of the mythical creations, the natural genesis and typology of the fall in heaven and on earth, of the deluge and the ark, of the natural genesis of time and the typology of the word or *logos*, and the typology of equinoctial christolatry.

We must at once admit that there is in this volume, even more than in the former one, much which cannot be legitimately discussed in the "Journal of Science," and much, also, which we are not qualified to deal with anywhere. To certain passages, especially in the earlier chapters, we may here, however, direct attention. Concerning the commonly accepted meaning of the word Paradise the author says:—"This comes of looking for the old lost Paradise in the shape of a Hebrew garden. *Pardez*, the Armenian paradise, the Persian *pardis*, the modern Arabic *firdaus*, applied to park or garden, is too late an application for an interpretation of the beginnings. Human gardens were not inclosed or cultivated when the Paratesh was formed."

Speaking of the *Airyana-vaejo* of the Avesta, Mr. Massey writes:—"This was at one time considered by the 'best authorities' to have been the starting-point of successive and most ancient migrations of the much overlauded Aryan race. But mythology and its naming preceded geography."

Concerning the origin of mankind the author says—"The creation of man or of men in the primordial mythes has no relation whatever to human beings, but to the earliest representations of celestial phenomena. It is so common a mode of expression that anthropologists even speak of the 'first man' as if he were a reality. We are frequently informed that such an one was the 'Adam,' the 'first man' of this or the other people, as if that explained anything. There is no more a first man in mythology, as a human being, than there is a primal individual parent known to Evolution. There never was a first man. That is, there never was a time when there was not a whole species of the animal at whatsoever stage of development, and the earliest myth-makers did not pretend to know anything about a first man, as a human being."

In summing up the most important teachings of this chapter Mr. Massey says—"Speaking generally the creations are stellar, lunar, and solar; the series corresponds to that of the heavenly bodies which in the Avesta, for instance, is invariably given in the order of stars, moon, and sun, where we should say sun, moon, and stars. That which was latest with the earlier men becomes first with the later, and thus we have been *grounded in non-evolution* as a mode of education; consequently much of our current explanation of the backward past in history, religion, mythology, and theology, is akin to that which accounted for the fossils found on mountain-tops, by supposing that pilgrims in passing from land to land had dropped their cockle-shells."

We regret that lack of space forbids us to give the author's appreciation of Buddhism, which in these days of "Occultism" will not be received with unmixed approval.

We cannot conclude this brief notice without bespeaking for the "Natural Genesis" the careful attention of anthropologists. Like ourselves they will probably feel unable to accept all the author's conclusions, but, again like ourselves, they will feel that he has at least been working in the right direction.

Accented Five-figure Logarithms of Numbers from 1 *to* 99999, *without Differences.* Arranged and accented by Lewis d'A. Jackson. London: W. H. Allen and Co.

The author, in his Introduction, advocates the use for ordinary purposes of four- or five-figure logarithms in place of the seven-figured. He remarks that the computers in the Nautical Almanack office can calculate the whole of their occultations, almost all their eclipses, and all the places of the stars except the circumpolar ones, with four-figure trigonometrical logarithms, giving minutes of arc. Wherever the entire seven figures cannot be utilised, their employment is a waste of time and labour. By his system of accentuation he offers a remedy for the defects of five-figure logarithms, as he has done in a previous work for those of four figures. The author denotes, *e.g.*, log. 88637 by $9476\bar{2}$, log. 88638 by 94762, and log. 88639 by $9476\underset{.}{2}$; the two signs, the dash above and the dot below, have the same mean value, one being 0·3 less and the other 0·3 more than the first plain number. Instructions, with examples, are then given for computing with accented logarithms.

In addition to the table referred to in the title-page, there is a table of accented five-figure logarithms for sines, tangents, co-tangents, and cosines of angles from 0° to 90°, to every hundredth of a degree.

The work finishes with a comparative table of French and English decimal scientific systems. Many of our readers will not require to be told that Mr. Jackson has re-cast the decimal system of weights and measures in a manner which, while retaining its advantages, does away with the objections urged against it by practical men. In particular, he has introduced or retained plain short names for the different denominations in place of the awkward and lengthy terminology which the French unhappily introduced.

Longman's Magazine. No. XII. October, 1883. London: Longmans and Co.

We find here a very remarkable paper, by Dr. B. W. Richardson, entitled "Cycling as an Intellectual Pursuit." In this light we suspect it will have been very rarely regarded, the more as a large part of its votaries do not seem overburdened with intelligence. The writer begins with a confession which we hope is not true of the majority of men, even when well advanced in years. He says:—"If I walk ten miles in three hours—a fair pace—I am tired: my ankles feel weak, my feet sore, my muscles weary; so that after the effort I am unfitted for any mental work until recruited by a long rest." Such inconveniences after travelling the same distance on a tricycle Dr. Richardson does not feel, but, on the contrary, is "agreeably refreshed and ready for study or other mental occupation."

After this comparison, unfavourable to man's natural locomotive organs, he goes on to show the physical advantages of "cycling," to defend it against objectors, and to record the performances of various persons with the two- or the three-wheeled machine. At last we come to the pith of the matter. The suggestion the author has to offer is "that the ladies and gentlemen who at this time are making cycling a pastime should form themselves into an association for collecting various kinds of information while they are carrying on their excursions in this and in other countries." He suggests the organisation of such a Society, and its division into four sections,—an archæological, a geographical, a natural-historical, and a mechanical. The members of the Society are to collect information under these heads, to hand it for collation to local offices, whence it is to be transmitted to the head-quarters of the Society.

We will now endeavour to form an estimate of the feasibility of this startling proposal. It strikes us that the cyclist moves too fast for anything like a close observation of Nature, whilst, however skilful and experienced he may be, some portion of his attention will be drawn off to the management of his machine. Again, he is almost exclusively confined to the main roads: the woodland paths, the mountain declivities, the precipitous river-banks, the marshes, and peat-moors, where respectively the botanist, the entomologist, the mineralogist, &c., find their best harvests, must be for him forbidden ground. Or if he leaves his "cycle" on the road, and goes on foot into the thickets and among the rocks to make the explorations, he will be continually under the necessity of coming back to his mechanical roadster. Hence he will find himself at a heavy disadvantage as compared with the pedestrian.

But possibly Dr. Richardson may mean that the cyclist is merely to travel down by machine to some central spot, take up his quarters there, and explore the neighbourhood on foot. This, of course, will be perfectly feasible, and the tourist will then be in no worse and no better a position than if he had come from home by train or by ship.

It must also be remembered that—at least as far as Natural History and Archæology are concerned—that minute exploration which Dr. Richardson thinks his associated cyclists might effect, is being already done by local societies. These bodies are now numerous, earnest, and disposed to co-operate with each other. They are making minute examinations of the floræ and the faunæ of their respective districts, and noting down the geological features. In France, and still more in Germany, the same work is being carried on. Almost every town of any standing has its *Naturforschende Gesellschaft*, whilst every University, every Real-Schule, and nearly every Gymnasium sends out its bands of explorers during vacation. We are far from saying that everything, even in Central Europe, is fully explored; but in the most promising districts a cycle of any kind would be found decidedly *de trop*.

Nor can we forget that the cyclicts as a body are not trained observers, and would, perhaps, not readily become such. The habit of skimming along level roads at a rapid rate, thinking of little but how many miles can be got over in the day, is a poor preparation for seeing everything and into everything.

Altogether we are inclined to think Dr. Richardson's suggestion as lacking in the practical element.

"Toads, Past and Present," by Mr. E. Kay Robinson, is a curious summary of the traditional notions concerning toads. He writes:—"For many years the semi-scientific public had learned to regard the toad as a perfectly harmless reptile. Real Science, however, in the guise of the 'Lancet,' has come more or less to Shakespeare's rescue; for that journal last year discovered, *more suo*, that the venom [secretion of the cutaneous glands] of a toad injected beneath the skin of a dog produces convulsions." Now that the toad, like certain other Batrachians, has a poisonous secretion was known a good many years before this alleged discovery. Still, as the reptile has no means of introducing this venom into the bodies of other animals, it is practically harmless, and the semi-scientific public is in the right. We can, from our own superabundant experience, deny that there is any danger in handling toads.

The Popular Science Monthly. October, 1883.

We find in this issue much matter deserving a careful consideration. Foremost stands a reply by Paul R. Shipman to the paper recently read by Dr. Lionel Beale before the Victoria Institute, and republished by that body in the form of a pamphlet. Dr. Beale, we are told, admits by implication that known causes have not yet been proved inadequate to explain the phenomena of life. His cautious statement is that they are inadequate "*in the present state of scientific knowledge.*" Hence his assumption of a special power to account for the phenomena peculiar to living beings is declared a violation of the principle known in older philosophical literature as "Occam's razor," but now more generally known as the "law of parsimony." This law forbids the assumption of an unknown cause before the inadequacy of known causes has been demonstrated. Those who carefully read this paper will scarcely find their respect for Dr. Beale as a thinker undiminished.

Dr. E. Bayard communicates a paper bearing the unhappy title "Homœopathy as a Science." One of the first signs of the approaching millennium will be a cessation of this misuse of the term Science. It has been again and again enforced by men of the highest ability that Science merely perceives and declares what exists. To do anything, or to instruct man how or what to do, belongs in the province not of Science, but of Art. Homœopathy, whether it be the correct method of treating disease or no,—a question into which we cannot enter,—is no more a Science than allopathy, or than metallurgy, or pyrotechnics, all *arts* aiming at certain ends.

Dr. F. Oswald gives one of his clever, but one-sided, papers on the "Remedies of Nature." He denounces tea and coffee as evils of the same class as tobacco, opium, and alcohol, to which they lead the way. As usual he advocates vegetarianism. He speaks of Bichat proving "that our digestive organs are those of a frugivorous [phytophagous] animal." We would defy any Bichat to prove that our digestive organs are less adapted for a mixed diet than are those of the majority of the Rodents (Muridæ, Sciuridæ, &c.), of the Suidæ, or of the monkeys, which are well known to consume eggs and insects—animal matter as truly as beef or mutton. Dr. Oswald tells us that the first taste of every poison is either insipid or repulsive. Is this the case with certain poisonous fishes and fungi, and with some kinds of poisonous honey? "The only safe, consistent, and effective plan is Total Abstinence from all Poisons." But if we are entirely to abstain from all substances which would prove fatal or injurious if taken in large doses or in a concentrated form, our diet will be strangely limited. The ordinary garden fruits and vegetables contain such acids as the tartaric, malic, citric, &c. Are they therefore to be rejected? Nevertheless there is too much truth in the paper before us.

"The Historical Development of Modern Nursing," by Dr. A. Jacobi, corrects a widespread error. It is commonly supposed that hospitals are an outcome of Christianity; but the author shows that they existed in Ceylon, under Buddhist auspices, in the second, and even in the fifth, century before the Christian era. May not their absence in the days of classical antiquity be in part due to a smaller prevalence of chronic disease? With the abolition of the baths public health must undoubtedly have declined.

The English Illustrated Magazine. No. 1. October, 1883. London: Macmillan and Co.

THERE is in this bright and clever new journal little which can legitimately come under our cognizance. There is a paper, by Mr. Grant Allen, entitled "The Dormouse at Home," which is so good a specimen of the author's manner of treating natural history subjects that a signature was scarcely necessary. Mr. Allen views the dormouse as a "central meeting-place whence all the radiating threads of the rodent pedigree diverge in the various directions of the rats, the mice, the squirrels, the marmots, the prairie dogs, and even the beavers."

"The Supernatural Experiences of Patsy Cong" is a tribute to the spiritualistic tendencies of the present day, but the strange occurrences described are left unexplained.

"Oysters and the Oyster Question," by an Inspector of Fisheries, is the first portion of a Lecture delivered at the Royal Institution in May last.

The Mason College Magazine. October, 1883. Birmingham: Cornish Bros.

WE are glad to find this bright little magazine reappearing after its summer recess. We notice a humorous article entitled "Robinson Crusoe, B.Sc., an Autobiography." Here those acquainted with local circumstances will doubtless be able to find more than meets the eye of the stranger.

A Member of the Natural History Society is credited with the following invocation:—

"O Sancte Herberte
    Lucem da nobis
Rex philosophorum
Dux syntheticorum
In sæcula sæculorum
    Lucem da nobis!"

"Vox Clamantis in Deserto" gives a list of miscellaneous requirements, among which we perceive, with satisfaction not unmingled with amusement, "A Society for the Liberation of Physiology from Tait Patronage and Control." Decidedly necessary, as the "patron and controller" is evidently impenitent.

A New Departure in Medical Electricity. By S. A. MORTIMORE FOOTE. Morton and Burt, Printers, Edgware Road.

FROM this little work we extract the following passage:—"I assert that *Electricity acting on flesh deprived of blood or fluid is a deadly poison. This is a very strong statement. Bring it to the test of experiment.* Nothing is easier. The writer would not dare to try it on his own person, so confident is he that the statement is perfectly true. Pass a piece of tape or string round a finger so as to press backwards all the fluids in the vessels. Then apply to the *bloodless flesh* a very feeble current, say from one cell, for a fraction of a second, and note the blood poisoning that ensues, and I venture to assert it will not invite repetition. Mind, this is not a theory. Everyone can test it at his own cost. *This I claim as my great discovery.*" (The italics are the author's own.)

We are not going, in comment, to assert what might or might not be the consequence of applying an electric current to "flesh deprived of blood or fluid." We have never made the experiment. Nor would it be at all easy. A ligature applied to the finger greatly checks the circulation, but it does not expel the fluids from the vessels. If the author doubts this statement let him tie a tape tightly round a finger, and then plunge a needle into the flesh below the ligature. He will find that it is by no means "deprived of blood or fluid." We do not give any opinion as to the results of applying an electric current to the extremity of a finger thus tied. They may possibly be disastrous; but in any case they cannot be due to the absence of fluid.

Mr. Foote's contention that electricity is often ignorantly applied no one can gainsay. The medical electrician is too often a quack of a very dangerous grade, and, if not altogether ignorant of electrical science, is often utterly unacquainted with physiology.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE STRUGGLE FOR EXISTENCE.

To the Editor of the Journal of Science.

Sir,—Possibly the subjoined demonstration, that excessive competition in any sphere tends to frustrate its own ends, may be novel to some of your readers.

Let us suppose a large public building—church, theatre, lecture-room, or what you please—full of people. When the proceedings are at an end it will be quietly and quickly emptied. But suppose that each person, on entering, sees an announcement that the first fifty persons who make their exit after the end of the meeting shall receive a sovereign each, the next hundred half a sovereign, and the next—say two hundred—five shillings each. What will be the result ? There will be a severe struggle, and, independent of damage to life and limb, the building will probably take twice as long to be cleared as under ordinary circumstances.

Now let us suppose the competition yet intensified : let the public on entering find an announcement, issued by some competent authority, that the last hundred or two hundred who issue from the place will be liable to heavy penalties, fine, or imprisonment. The struggle will become desperate, numbers will be trodden under foot, and the hall will not be emptied in four- or fivefold the usual time.

It may be said that such cases are entirely imaginary, and that we know not what would happen. This reply is founded on an error. Only a few months have passed since the offer of a few trifling toys allured a couple of hundred children to their death. And the effect of a terror behind the multitude was shown a few years ago at the cathedral of Santiago, where but a few of an immense throng of worshippers ever succeeded in making their exit at all. Can the meaning of these instances fail to be understood ?—I am, &c.,

G. C.

PAYMENT BY RESULTS.

To the Editor of the Journal of Science.

SIR,—I have been much edified with Mr. Galloway's suggestion in your last issue, that the permanent officials of the Science and Art Deparment, as well as the Science teachers, should be paid by "results." If anyone asks what results are to be considered satisfactory, I should say the decrease of the foreign designers, chemists, engineers, &c., in our manufactories, and their substitution by natives. Did I see any movement in this direction I should feel convinced that the Department was at any rate moving in the right direction.

I think a return of the number of aliens filling places of trust in our industrial establishments would be a very instructive document, and would throw no little light on the question of technical education. Perhaps some Irish M.P. might move for such a return if no Englishman dare.—I am, &c.,

INCOLA.

NOTES.

Dr. T. S. Hunt, F.R.S., brought forward at the late meeting of the American Association a new classification of the Sciences. Under the head *Mineral Physiography* he includes Descriptive and Systematic Mineralogy, Geognosy, Geography, and Descriptive Astronomy. Under *Mineral Physiology* rank Physics, Chemistry, Geogeny, and Theoretical Astronomy. In like manner the Sciences of Organic Nature are divided into Biophysiography and Biophysiology, the former of which heads comprises Organography, Descriptive and Systematic Botany, and Zoology, whilst the latter embraces Biotics, Organogeny, Morphology, Physiological Botany, and Zoology.

Dr. C. C. Abbott (" Science "), in a very interesting paper on the Intelligence of Birds, records that he " girdled " the branches of an alder in which a summer warbler (*Dendrœca æstiva*) and a white-eyed vireo (*Vireo novaboracensis*) had built their nests. The leaves consequently withered, and the nests were at once abandoned. But in a similar experiment where the nest contained young birds, the parents, though annoyed at the exposure, remained. He placed some short pieces of woollen yarn—red, yellow, purple, green, and grey—near the half-built nest of a Baltimore oriole ; the birds made use of the grey yarns and a few of the purple when the nest was nearly complete, but left the red, yellow, and green yarns undisturbed.

Prof. E. D. Cope (" Science ") has discovered, in the Eocene, an ungulated animal with carnivorous jaws.

We are happy to see that a serious movement is being made to establish a marine station for scientific, and especially biological research, at Granton, near Edinburgh.

The results of Prof. Nordenskiöld's expedition into the interior of Greenland must convince the world of the essential unfruitfulness of Arctic exploration. We might indeed, were the ice removed, find an interesting fossil fauna and flora ; but how is this to be done ?

Prof. E. D. Cope's paper on the Evidence of Evolution, as found in the " History of Extinct Mammalia," is, and was meant to be, a telling answer to Principal J. W. Dawson's anti-evolutionist presidential address.

" Science " characterises the climate of Minnesota by saying that " cranberries and rheumatism abound."

According to the "Revue Spirite" charges are brought against Prof. Mendelejeff, and certain of his colleagues at the University of St. Petersburg, of having smothered an enquiry into the truth or falsehood of Spiritualism, and shown bad feeling and bad faith.

Mr. J. Chatin has examined the apical club of the antennæ of *Vanessa Io*. It is covered with minute fossæ, narrower at the orifice and widening within, and having at their bottom the so-called *olfactory* rods, which vary in number from one to four in each fossa.

At the late meeting of the British Association Mr. Francis Galton presented an interesting Report on the Federation of the Local Scientific Societies.

We learn from a medical contemporary that a prominent anti-vaccinationist has committed suicide, as a sequel to the death of his wife and of three of his children from smallpox.

MM. Olivier and Richet ("Comptes Rendus") have established the mobility of the microbia found in the lymph of fishes, thus distinguishing them from a new histological element which they have discovered in the same medium.

Prof. E. Ray Lankester, in his Presidential Address delivered before the Biological Section of the British Association, pleaded urgently for the establishment of laboratories or stations for biological research in England. We trust that his plea may not prove in vain. But of this elsewhere.

We find in "Light" the following most deplorable comment upon Prof. E. R. Lankester's recent plea for the establishment of laboratories for biological research:—"Professor Lankester, of Bow-street notoriety in connection with the case of Dr. Slade, pleads for 'the Endowment of Research,' which appears to be that he and such as he should be subsidised by the State, such people being generally understood to be in search of knowledge, but not bound to teach it, or to produce results! But Professor Lankester was always very modest!" Prof. Lankester and "such as he" have already furnished very valuable results, and would do more if they had the scope afforded them. To think that the scientific discoverer should spend his time in teaching is as unreasonable as to expect the manufacturer to retail his own products.

The Java catastrophe seems to many persons a confirmation of the alleged disappearance of Atlantis.

An important new work by Robert Hudson Graham, C.E., will be shortly issued by Messrs. Crosby Lockwood and Co., London, entitled "Graphic and Analytic Statics in Theory and Comparison;" their practical application to the Treatment of Stresses in

Roofs, Girders, Bridges, Arches, Piers, and other Frameworks; with a chapter on Wind Pressures, and a number of diagrams and plates to scale, with examples—many taken from existing structures. The same publishers also announce for immediate publication, "The Art of Soap-making," a Practical Handbook of the Manufacture of Hard and Soft Soaps, Toilet Soaps, &c., by Alexander Watt; "The Engineers' and Shipowners' Coal Tables," by Nelson Foley, author of "The Engineer's Office Book of Boiler Construction": and the following works in their popular "Weale's Rudimentary Series":—"Farm Buildings," a Treatise on the Buildings necessary for various kinds of Farms, and their Arrangement and Construction, with Plans and Estimates, by Professor John Scott (being the fourth volume of Scott's "Farm Engineering Text-Books"); and a revised and enlarged edition of "Sanitary Work in the Smaller Towns and Villages," by Charles Slagg, A.M. Inst. C.E.

A journal is now published in Germany devoted to the study of Fungi, from a botanical, physiological, and economic point of view.

Mr. C. H. Fernald, of the Orono State College ("American Naturalist"), mentions that a horse went alone, and without the knowledge of his owner, to a blacksmith's forge to have one of his shoes rectified.

Says an ultra-heretical journal, "Darwin was a laborious physicist, but no thinker to speak of. Taxonomy is not thought." We ventured to foretell, some years ago, that the great naturalist would before long fall into disgrace among "advanced thinkers."

Mr. W. N. Lockington ("American Naturalist") ably combats the paradox of Prof. Minot that man is not the highest animal.

Mr. J. S. Kingsley, in the same journal, questions the validity of the group Arthropoda, and points out important heterologies of structure between its two component sub-groups, Crustacea and Tracheata.

The editors of the same journal say judiciously, concerning certain troublesome neologisms, "What theologians are pleased to call the 'natural,' man rightfully rebels against an overstrung nomenclature."

A very large portion of the world's annual yield of platinum is obtained from the Upper San Juan.

M. J. Delauney ("Comptes Rendus") proposes the following law on the occurrence of earthquakes, &c.:—"The majority of the phenomena of cosmic and terrestrial meteorology, and in particular the great seïsmic tempests, seem to take place when the larger planets pass certain longitudes, especially 135° and 265°."

Evolution does not appear to have found grace in the sight of the Church Congress. It was discussed by the Bishop of Carlisle, Mr. Aubrey Moore, Prof. Pritchard, Bishop Perry, Prof. Engstrom, and Mr. W. D. Gounod, who are said to have been "frequently applauded."

A tribe of Indians having decided tails, 6 to 8 inches long, is said to have been discovered in Paraguay. Should this announcement prove true we must protest against them being paraded as "the missing link," since the anthropoid apes are tailless,

The Municipality of Lisbon has decided that cremation is permissible under ordinary circumstances, but must be compulsatory in case of epidemics.

The French Association for the Advancement of Science devotes a large share of its attention to economic and engineering questions, thus savouring strongly of politics and of finance.

We greatly regret to learn the death of the illustrious Swiss palæontologist, Oswald Heer.

The brain of Carey is said to have had the unusual weight of 63 ounces.

The "Medical Press and Circular," criticising Dr. Clifford Allbutt's speech at the amalgamation of the Leeds School of Medicine with the Yorkshire College of Science, justly remarks that on the Vivisection question the medical profession "blustered a good deal too little; had they spoken out boldly, declined a deceptive compromise, and taken every possible opportunity of exposing the misrepresentations and sophistries of the Anti-Vivisection fanatics, the agitation would have been stamped out by this time."

Mr. Bradford Torrey ("Science") disproves, from actual observation, the assertion of the Duke of Argyll that no bird (humming-bird) ever flies backwards.

An effort is being made to place the American signal or meteorological service in the hands of civilians. Its present military organisation is open to not a few objections.

According to the "Posener Zeitung" a workman was arrested in the Sapieha-Platz, Posen, "for having in his possession three bottles of living ants, which he was offering for sale."

Veth and Van Hasselt ("Deutsch. Geogr. Blätter.") have published an account of their ascent of Indrapura, the loftiest of the Sumatran volcanoes. The height of the mountain is 3700 metres (about 11,500 feet), and the temperature at the summit 8° C. The region of large trees comes to an end about 2500 metres.

Mr. G. Jinman, F.R.G.S., in a circular, maintains that storms are periodic in their arrival, and are governed by perfect laws. He rejects the circular or spiral theory, and insists—in opposition to Mr. Scott, of the Meteorological Office—that storms give more than forty-eight hours warning of their approach. The importance of the subject surely warrants a full and fair enquiry.

Mr. C. S. Mixter (" Science ") gives reasons for thinking that the relative increase of the negro and negroid population of the United States is not so rapid as it has been feared.

MM. Cornil and Berlioz (" Comptes Rendus ") show that the bacilli of the jequirity produce serious disease if introduced into the animal system. Frogs and fishes succumb more readily than the small Mammalia.

There is difference of opinion as to whether birds leave the neighbourhood during an epidemic of cholera. The discussion so far consists merely of flat assertion and flat denial.

" Science," in an able article on " National Traits in Science," writes :—" Very noteworthy is the fertility of the English in generalisation : this is with them a process of individual effort quite unlike the German democratic method of generalising by the accumulations of many. Is it too much to say that the English and Scotch are the Greeks of modern philosophy ? "

Dr. Jackson, whilst hunting in the jungle near Pachmarree, India, was attacked by hornets, which stung him so seriously that he died within two days.

We regret to find that we have omitted to record the death of Dr. Hermann Müller, one of the most able and successful coadjutors of Charles Darwin.

The " Medical Press and Circular " speaks of Prof. Huxley's " ready acquiescence in existing evils." Prof. Huxley is, however, reported as saying—" If it should so happen that a Claude Bernard or a Ludwig should turn up in London among you gentlemen, at the present time, I really do not know what we should do with him ; I do not think we could turn him to account. I think we should have to export him to Germany or France."

Dr. A. L. Child (" Kansas Review of Science ") gives abundant evidence that the concentric rings of trees are no trustworthy indication of their age.

Prof. S. A. Forbes (" Science ") is investigating the epidemic among caterpillars known as " Schlaffsucht," and has traced it to Micrococci.

The October number of the " Journal of the Royal Microscopical Society " contains a translation of a paper, by L. Olivier, on " Practical Processes in Vegetable Histology " (Rev. Sci. Nat., i., 1882, pp. 436 to 454; ii., 1882, pp. 71 to 91). Most of the processes used in the examination of animal tissues have been brought to great perfection; the same elaborate methods do not seem hitherto to have been applied to the study of vegetable structures; in fact, the subject is rather behindhand. The following subjects are discussed :—Clarification, Fixation of Forms, Contraction, Precipitation and Crystallisation, Dissolution and Destruction, Colouring, Preservation. A full account is given of the various reagents employed, and manner of observing tissues under such treatment. The Anti-Vivisectionists may probably object to experiments on living tissues, having for their object the induction of contraction in the cell-contents, and the staining of living organisms, as was done by Certes, for exhibition to the members of the Zoological Society of France: probably English botanists may ere long be compelled to *boil* their plants before experimenting on them. The colours available for this purpose are aqueous solutions of cyanine and aniline brown (Bismarck brown). "These results are important: by taking these into consideration in the future we may be able to study, on the living subject, the phenomena of conjugation and reproduction in the Algæ and Infusoria, instead of being, as hitherto, confined to the study of the organisms killed in different stages of their evolution." This process will probably give good results with some of the lower Algæ, which have hitherto involved much tedious observation. With respect to mounting in Canada balsam, exception must be taken to the statement "that, by reason of the difference of the refractive powers, it is preferable for the preservation of diatoms." Mr. J. W. Stephenson has shown that its refractive index is too close to that of diatomaceous silex, and that media of higher refractive index can be used with the result of producing much greater visibility ("Journal of Science," 1881 and 1882). The references to authorities are very numerous, but, after the usual custom of French and German authors, the existence of any English observers is studiously ignored. The paper is a valuable one, and might have remained unknown to the majority of English students but for the enterprise of the Royal Microscopical Society.

The same number also contains an exhaustive and beautifully illustrated paper, by C. T. Hudson, LL.D., F.R.M.S., "On *Asplanchna Ebbesbornii*, a New Rotifer." This is a valuable contribution to Science. It is to be hoped that Dr. Hudson's monograph may soon appear, as information respecting the Rotiferæ is at present scattered through the periodical literature of many years.

Twentieth Year of Publication.

THE

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THE

JOURNAL OF SCIENCE.

DECEMBER, 1883.

I. EARTHQUAKES AND ELECTRICITY.

By Colonel ARTHUR PARNELL, late Royal Engineers.

ON a beautiful starlight evening towards the close of July, 1883, some two thousand Italians, residing or temporarily staying in a pleasant island in the Bay of Naples, were suddenly summoned to render up their lives. By a sharp convulsion of the earth's surface the tall masonry houses of Ischia were in a few seconds transformed into the tombs of a great company of men, women, and children, whose souls passed to the nearer presence of their Creator through the medium of one of the most agonising and pitiable deaths that it is possible to conceive. Are we to look on this heart-rending event as simply a random wanton freak of Nature? Or are we to consider it as a lesson especially directed to men of education and science, to teach them that the terrible physical plagues known as earthquakes are occurrences that need the most earnest investigation and reflection, with the view of haply lighting on the means of preventing them? Is the signal success that attended Jenner's efforts to avert the dreadful pestilence of smallpox to be consigned to dark oblivion? Or shall we endeavour to follow his footsteps by carefully examining the conditions and effects of earthquakes, in the hope of discovering their cause?

Within the limits of a brief paper like the present one scope does not exist for dealing exhaustively, or even fully, with the various circumstances—physical, meteorological, and geographical—that permeate and environ the great subject of earthquakes. But the writer trusts to be able to throw perhaps a few gleams of light along a short distance of a path that may possibly, if patiently explored, eventually lead to the desired goal.

In a very interesting article on "Earthquakes; their Cause and Origin," that appeared in the "Quarterly Review" for July, 1881, the author (whose name is unknown to the present writer) mentions the following theories as the principal ones that have from time to time been enunciated as probable causes of these phenomena :—

1. Water expanding into steam on coming into contact with subterranean lava.
2. Chemical changes or combinations within the earth.
3. The shrinking and cooling of the earth's crust.
4. Rupture by tension.
5. Collision between solids and a liquid.
6. The passage of a wave of elastic compression causing each particle of earth to perform a vibratory movement.
7. An incomplete effort to establish a volcano.

But in the opinion of the reviewer the cause of earthquakes was attributed to electricity, and his paper contained strong arguments in favour of this idea, though no allusions were made to the writings of previous advocates of the electrical theory. The present writer is equally impressed with the belief that electricity is the true source of earthquake phenomena, and he had already published his views on the matter (in connection with thunderstorms) before he was aware of the existence of another worker in the same field ; and he now proposes to submit a slight historical notice of some of the suggestions that have at different times been advanced in connection with the association between earthquakes and electricity.

The most ancient allusions to the subject are probably those contained in the Scriptures. After the arrival of the children of Israel in the wilderness at the foot of Mount Sinai, on their journey from Egypt to Canaan, "it came to pass on the third day in the morning that there were thunders and lightnings and a thick cloud upon the Mount, and the voice of the trumpet exceeding loud ; so that all the people that was in the camp trembled. And Moses brought forth the people out of the camp to meet with God ; and they stood at the nether part of the Mount. And Mount Sinai was altogether on a smoke, because the Lord descended upon it in fire ; and the smoke thereof ascended as the smoke of a furnace, and the whole Mount *quaked* *greatly*" (Exodus xix., 16—18). We thus see how the giving of the Old Law to the chosen people was ushered in by grand physical manifestations; and the thunderstorm and earthquake which they included would appear to be intimately combined in one common source.

Now let us turn to a very different portion of the Holy Writ—to scenes of exquisite imagery foreshadowing by sign and metaphor the eve of a New Law and of a new order of things:—"I saw the seven angels which stood before God; and to them were given seven trumpets. And another angel came and stood at the altar, having a golden censer; and there was given unto him much incense that he should offer it with the prayers of all saints upon the golden altar which was before the throne. And the smoke of the incense which came with the prayers of the saints ascended up before God out of the angel's hand. And the angel took the censer and filled it with fire of the altar, and cast it into the earth; and there were voices and thunderings and lightnings and *an earthquake*" (Rev. viii., 2—5). Again, "The seventh angel sounded, . . . and the temple of God was opened in heaven, and there was seen in his temple the ark of his testament; and there were lightnings and voices and thunderings and *an earthquake* and great hail" (Rev. xi., 19). And again, "The seventh angel poured out his vial into the air; and there came a great voice out of the temple of heaven from the throne, saying, It is done. And there were voices and thunders and lightnings; and there was *a great earthquake*, such as was not since men were upon the earth, so mighty an earthquake and so great" (Rev. xvi., 17, 18). It seems impossible to doubt that the Inspirer of these three passages looked on lightnings and earthquakes as being branches of one and the same agency.

Descending now to secular history we find the following remarkable extract from Pliny's writings, quoted by Alexander Von Humboldt in his famous "Cosmos":—"Ventos in causa esse non dubium reor. Neque enim unquam intremiscunt terræ nisi sopito mari cæloque adeo tranquillo ut volutus avium non pendeant, subtracto omni spiritu qui vehit; nec unquam nisi post ventos conditos scilicet in venas et cavernas ejus occultu afflatu. Neque aliud est in terra tremor quam in nube tonitrum; nec hiatus aliud quam cum fulmen erumpit, incluso spiritu luctante et ad libertatem esire nitente."—(Humb., I., 193; Plin., II., 79.) In this last sentence the co-ordination of thunderstorms and earthquakes is clearly recognised. And whilst in ignorance of the existence of the force of electricity, it is by no means unreasonable that the frequent occurrence of earthquakes immediately after a period of sultry atmospheric calm should have originated the idea suggested in the first sentence, that they were caused by the bursting forth of the imprisoned winds. (After all, who knows even now but that winds may in some respect be due to electrical action ?)

In modern times it would appear that Dr. Stukeley was the first person who advanced the view that earthquakes were probably caused by electricity. This was on the occasion of the earthquakes that happened in 1749 and 1750, at London and at Daventry (in Northamptonshire) respectively. Stukeley's papers were read before the Royal Society on March 22nd, 1749, and on December 2nd, 1750. He shows that during these years thunder, lightning, auroræ, and meteors had been remarkably prevalent throughout England, and the whole of his arguments are well worthy of study. But whilst Stukeley was thus urging this theory a philosopher in the South of Europe was at the same time, and without any knowledge of Stukeley's labours, proceeding on the same course. This southern physicist was a native of Turin and a Roman Catholic priest. His name was Giambattista Beccaria. In 1753 he wrote "Dell Elettricismo artificiale e naturale," and in 1758 "Lettere dell Elettricismo." If the theory of the electrical origin of earthquakes should ever gain acceptance it is to this great man that the honour should be awarded. Of him the following remarkable testimony is given by his contemporary, the well-known Dr. Priestley:—"All that was done by the French and English electricians with respect to lightning and electricity fell far short of what was done by Signor Beccaria at Turin" (Hist., 315). Again, in regard to experiments made by *savants* for ascertaining the electricity in the air, "Signor Beccaria made, however, the most extensive and accurate experiments on this subject" (Hist., 338). And again, in connection with the heterodox views of Mr. Wilson regarding pointed lightning-rods, he alludes to Signor Beccaria as one "whose observations and experience with respect to lightning give a weight to his opinion superior to that of any man whatever" (Hist., 373): and this he writes at a time (1775) when Benjamin Franklin was, so to speak, in the zenith of his physical fame. Beccaria appears to have made experiments and researches on terrestrial electricity for a period of some twenty-five or thirty years, and he became firmly rooted in the belief that not only were lightning-strokes (or thunderbolts) due to the earth's electricity, but that also earthquakes, auroræ, and whirlwinds were derived from the same cause. It is most noteworthy that he, one of the great pioneers of electricity, one of the men who attended at its birth,—the man who above all his fellows minutely searched into its operations and effects in regard to Nature, and the man who, of all the great labourers in the electrical vineyard (living as he did in Italy, a land which, probably far beyond other European lands, gives facilities to the natural philosopher for studying the action both of the thunderbolt and of the earthquake), had the greatest natural opportunities for arriving at the truth,—should have thus deliberately recorded his convictions respecting the electrical source of earthquakes. And it is equally remarkable that these convictions should have been deliberately rejected by almost every one of his contemporaries and successors. For to this day there is hardly a scientific man in Europe who entertains even Beccaria's view as to the earth-sprung nature of *lightning-strokes*. How then can we expect that, in the absence of this essential preliminary step, the whole development of Beccaria's theory could ever have been adopted?

We have already drawn attention to a great English philosopher of those times, *viz.*, Dr. Joseph Priestley, F.R.S., who wrote "The History and Present State of Electricity, with Original Experiments, the fourth edition of which appeared in 1775. On the mind of Priestley the researches and opinions of Beccaria had evidently made a strong impression, and it was in no faltering spirit that Priestley supported the views of his great master. The "Queries and Hints" on terrestrial electricity modestly propounded by Priestley are of a very pregnant nature. He says, "May not the void space above the clouds be always occupied with an electricity opposite to that of the earth? And may not the thunder, earthquakes, &c., be occasioned by the rushing of the electric fluid between them whenever the redundancy in either is excessive? Is not the Aurora Borealis, and other electrical meteors which are remarkably bright and frequent before earthquakes, some evidence of this?" . . . "Is not the earth in a constant state of moderate electrification?" . . . "And is it not probable that earthquakes, hurricanes, &c., as well as lightning, are the consequences of a too powerful electricity in the earth?" . . . "Supposing earthquakes to be caused by the discharge of a redundant electricity from the surface of the earth, might they not be prevented in countries subject to them by kites flying very high, with wires in the strings so as to promote an easy communication between the earth and the upper regions of the atmosphere?"—(Hist., 459.)

The next English writer to advert to the question appears to have been William Nicholson, who in 1787 wrote "An Introduction to Natural Philosophy." He adduces experience to combat the idea that earthquakes can be occasioned by subterranean explosions. But apparently he alludes to explosions of *vapour*, for he mentions the notion as "the common opinion." His notice is valuable as tending to show one of the possible reasons for the rejection, by the physicists of those days, of the theory of an electrical origin; for doubtless the only action they would conceive to result therefrom would be that of a subterranean explosion somewhat akin to a subterranean explosion between two clouds. Since, however (as Nicholson shows) facts demonstrated that the operation of earthquakes was chiefly of a *superficial* nature, the upheaval of the ground that must inevitably attend an explosion from below was probably deemed to be by no means in accordance with observation, and the electrical theory was therefore discredited. But to physicists of the present day conversant with the important class of electrical discharges known as *leaks* the surface nature of the action of earthquakes would appear to present a stamp of confirmation, rather than a stumbling-block.

A long interval now ensues, and Humboldt's "Cosmos" would seem to be the next important work that dealt with the question. The English translation (by Colonel, afterwards Sir Edward, Sabine, F.R.S.) of this "Sketch of a Physical Description of the Universe" was published in 1847. Besides the quotation from Pliny to which we have already alluded, much valuable information on the subject of earthquakes is furnished by Humboldt. He says:—"Active volcanoes may be regarded as safety-valves for the country in their immediate vicinity" (i., 202). . . . "The destruction of Lisbon, of Caracas, of Lima, of Cashmeer in 1554, and of so many towns of Calabria, Syria, and Asia Minor, shows that on the whole the most violent shocks do not usually take place in the vicinity of still active volcanoes" (i., 202). In allusion to the substances ejected at times from the earth—such as hot water, steam, noxious gases, mud, smoke, and flames—he says, "Do gaseous fluids issue from the interior of the earth and mingle with the atmosphere? Or are these meteorological processes the effects of a disturbance of the electricity of the atmosphere by the earthquake?" (i., 205). In regard to the association of earthquakes with thunderstorms he says, "On the coasts of Peru, where rain scarcely ever falls, and where hail, lightning, and thunder are unknown, these atmospheric explosions are replaced by the subterranean thunder which accompanies the trembling of the earth" (i., 205). Lastly, in respect of the probable affinity between the heat, electricity, and earthquakes:—"If, on the one hand, the internal heat of our planet may be connected with the excitement of electro-magnetic currents and the evolution of terrestrial light (auroræ) accompanying a magnetic storm, it is also a principal source of geological phenomena" (i., 189).

A great name in seismological literature now claims our recognition. To the late Mr. Robert Mallet, F.R.S., Science is much indebted for his magnificent record of the earthquakes that have occurred between B.C. 1606 and A.D. 1850—a list that comprises no fewer than 6831 instances of terranean convulsion. This account, together with most of his researches in the field of earthquake physics, is contained in various Reports made to the British Association during the years 1850 to 1854 inclusive. Hereafter we shall present a selection from Mallet's incidents; let us now notice some of his *dicta*. In regard to particular shocks which have caused fissures to open in the earth, and fire and smoke to issue therefrom, he says:—"The experiments of Becquerel and other electricians have shown that when fracture in a solid takes place a powerful electrical disturbance is the consequence. This will be great in proportion as the surface and mass fractured are in themselves large. When therefore a fracture of a mile long and of many feet in depth is formed, . . . the disturbance of electric equilibrium may be expected to exceed that of a heavy thunderstorm, and may *quoad* this part of earthquake phenomena realise the dreams of the older philosophers who thought that an earthquake was a thunderstorm under ground. In this then I believe is to be found the usual source of the flame or flash seen suddenly to appear and vanish at the mouth of the rent" (First Report, p. 54). He thinks that the smoke observed is probably in all cases *dust*. On the subject of the *malaise* that frequently (as with thunderstorms) precedes earthquakes:—"Animals, including pigs, oxen, horses, mules, dogs, geese, poultry, show presentiments of coming shocks by their uneasy manner. Human beings have sometimes a tendency before shocks to giddiness, headache, and nausea" (First Report, p. 68). He quotes Von Hoff in the following important passage:—"In all relations between this earth and its atmosphere the former is to be considered as the principal and the latter only as its appendage. The atmosphere is the child of the earth, and is supported by it" (First Report, p. 71). And again, in respect of the correspondence between earthquakes and terrestrial magnetism, Von Hoff *loquitur* :—"In many instances in which an opportunity of observing the magnetic needle during an earthquake has presented itself an alteration in its direction for the time has been observed." . . . "More remarkable, however, are the changes in the direction of the dip and variation needles, which take place at a distance from the place where the earthquake was observed, and at a place where the shock itself is not perceptible; as, for instance, in Paris on the 19th February and 31st May, 1822, simultaneously with an earthquake which occurred in Savoy and some of the southern parts of France. If this observation should be established by others carefully made, the existence could not be denied of a connexion between terrestrial vulcanism and terrestrial magnetism." Mallet himself supplies the following remarkable conception:—"Thus, then, ignorant as we are of all within the outer surface or skin of our globe (and of how much of its exterior, for the ocean shrouds two-thirds of it from our eyes?), we are compelled to see the close connexion of these mighty heating powers in which ignition is present on the vastest scale, yet without combustion, with the forces of terrestrial electricity and magnetism, forces which are those alone that within range of our observation are mutually convertible and both convertible into heat. Currents of both we know are ever passing, with variable activity, through enormous volumes of the earth's crust, the different parts of which possess very different conducting powers. Can it be that these currents, constrained to pass through narrow and bad conductors at vast depths in some formations, ignite them in their progress? Will it be found that the great lines of volcanic activity (as dreamed by Bylandt) are in some way connected with those of terrestrial magnetism?—are possibly normals to the surface curves of equal magnetic intensity? A glance at one of Gauss's magnetic maps, and at another of the great bands of active volcanoes on our planet, almost forces the mind into such conjectures" (First Report, p. 77). Yet this brilliant speculation seems to have fallen entirely to the ground, for the author of it consistently attributed the cause of earthquakes either "to the sudden formation of steam from water previously in a state of repulsion from the heating surfaces" (First Report, p. 80), or "to the passage of a wave of elastic compression causing each particle of earth to perform a vibratory movement" (Quart. Rev., July, 1881).

In the British Association Report for 1851 is a communication by Mr. R. Budge, F.R.G.S., regarding the great earthquake which took place in Chili during his residence there in that year. After describing the various circumstances of the event, he states that he cannot understand earthquake phenomena unless electricity be the agent (B. A. R. 1851, p. 85). In the same Association's Report for 1852 the well-known Dr. Buist, of Bombay, in a letter to Prof. Baden Powell, F.R.S., dated July 24th, 1852, says, "It is now well established that in India, at all events, earthquakes are almost always accompanied by furious storms of thunder, lightning, and rain; it is difficult to trace the cause of coincidences so remarkable in the commotions of the earth and the air" (B. A. R. 1852, p. 239). Again, in this Association's Report for 1864, the Rev. E. B. Ellmar describes a shock that occurred at Lewes, in Sussex, on the 21st August, 1864, and was preceded by copious showers (after three months of drought), accompanied by a great wave from N.W. to S.E., and followed by a thunderstorm, with vivid lightning, much hail, and two waterspouts. He then quotes a letter from Dr. Nicholson, of Tramfield, who says that he has frequently experienced shocks in the West Indies after a long drought, and that he is inclined to attribute some of these shocks to electricity as propounded by Dr. Stukeley (B. A. R. 1864, Trans. 16).

In his "Heat considered as a Mode of Motion" (1863) Prof. John Tyndall, F.R.S., quoting Prof. Dove, of Berlin, in regard to the earthquake at Caracas, of March 26th, 1812, graphically depicts Pliny's idea of a force imprisoned beneath the surface of the earth, and struggling to obtain freedom. "March 26th, 1812, began as a day of extraordinary heat in Caracas; the air was clear, and the firmament cloudless. It was Green Thursday, and a regiment of troops of the line stood under arms in the barracks of the Quarter San Carlos ready to join in the procession. The people streamed to the churches. A loud subterranean thunder was heard, and immediately afterwards followed an earthquake shock so violent that the church of Alta Gracia, 150 feet in height, borne by pillars 15 feet thick, formed a heap of crushed rubbish not more than 6 feet high. In the evening the almost full moon looked down with mild lustre upon the ruins of the town, under which lay the crushed bodies of upwards of 10,000 of its inhabitants. But even here there was no exit granted to the elastic forces underneath. Finally, on April 27th, they succeeded in opening once more the crater of Morne Garou, which had been closed for a century;

and the earth for a distance equal to that from Vesuvius to Paris rung with the thunder-shout of the liberated prisoner" (p. 172).

The anonymous writer of an article in "Blackwood's Magazine" for July, 1869, entitled "A New Theory of Earthquakes and Volcanoes," must now be noticed. The "new" theory advanced is the electrical origin of earthquakes; and the writer had evidently neither heard of the labours of Stukeley and Beccaria, nor had he examined the writings of Mallet, Humboldt, and Pliny. The paper is, however, of great interest, and the following are some of the author's conclusions:—"It is the earth which is the chief cause of all our thunderstorms." . . . "The atmosphere plays a secondary *rôle* compared with the solid earth." . . . "It is the condition of the earth's crust which forms the main element of electrical action." . . . "We may aptly describe earthquakes as thunderstorms in the earth." . . . "Volcanoes are vents which the subterranean electric action makes for itself, or for its effects, in those regions or localities where it is strongest or most permanent."

(To be continued.)

II. ON THE THEORY OF PHOSPHORESCENCE.*

By Br. Radziszewski.

IN a former investigation on the phosphorescence of organic and organised bodies, the author arrived at the conclusion that various organic bodies become luminous when they combine with active oxygen in presence of an alkali. All bodies whose luminosity has been tested, amounting to several hundreds, can be divided into two groups:—

1. Such as on the addition of an alkali become luminous when they already contain active oxygen, which is formed in them under the influence of an exciting agent,—*e.g.*, sun-light.

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* Read before the German Chemical Society.

2. Such as on the addition of alkalies form active oxygen and become phosphorescent during their combination therewith.

To the first group belong various hydrocarbons, the terpenes, &c. Some of these bodies at once give off light when exactly neutralised with barium peroxide, magnesia, milk of lime, or a strong solution of potassa, soda, or even sodium carbonate. They phosphoresce with especial beauty if heated with dry caustic potassa or soda, as is shown by the author's experiments with the oils of amber, calamus, and dill.

In the second group we find various aldehyds (chiefly polymerised), their ammonium compounds,—further, hydrobenzamide, lophine, anisidine, furfurine, and many other analogous bodies. In short, there belong here either aldehyds or bodies which reproduce aldehyds on treatment with alkalies, as the author has already proved in case of lophine.

These bodies, however, are not luminous in watery solutions, even if they are readily soluble in water; they must be treated with alcoholic solutions of alkalies only. This fact attracted the author's attention some time back, though he did not make it public until his researches on lophine had shown that this compound, in presence of water and in the absence of air, attracts the elements of water, and is converted into benzoic acid and oil of bitter almonds. In order to explain this fact the circumstance must not be overlooked that aqueous solutions of potassa form with the aldehyds chiefly resinous matters, whilst alcoholic solutions yield salts of the corresponding acids and alcohols.

The action is therefore twofold, and the process resolves itself into two stages. When the hydrogen which is at first liberated comes in contact with atmospheric oxygen, the latter is at once transformed into the active modification, and then follows the chemical process which gives rise to phosphorescence. Whether this activation of oxygen takes place at once according to Hoppe-Seyler's formula, or if hydrogen peroxide is first formed, is perfectly indifferent as regards the chemical act of phosphorescence, for hydrogen peroxide must first eliminate oxygen if the oxidation of the aldehyd is to take place.

In the author's memoir on the luminosity of fats, such as olive and almond oils, cod-liver oil, &c., he has shown that even when these bodies no longer phosphoresce, if briskly shaken the addition of a few drops of hydrogen peroxide is sufficient to reproduce the luminosity. In the same category as the phosphorescence of the aldehyds falls the observation of Lachowitz on the phosphorescence of phenanthraquinon in an alcoholic solution of potassa. Here there is first formed an aldehyd-like body which behaves like the aldehyds in general.

It is very probable that fats containing the glycerides of the acids $C_nH_2 -2O_2$ activate oxygen in the same manner. It is known that ricinoleïc easily yields œnanthyl-aldehyd; but the acids of the general formula above mentioned yield, with potassa, salts of two distinct acids, whilst hydrogen is set free. It is possible that under the influence of an alcoholic solution of potassa these acids attract the elements of water, and form—even at low temperatures—salts of the fatty acids and aldehyds.

The aldehyd thus formed undergoes in its nascent state a further action of the alkalies. Whether this mode of the activation of oxygen can be always identified with the origin of active oxygen in the living organism cannot be positively asserted. Still it is probable that such processes really occur in the living organism, since in it we find bodies of an aldehyd-like nature, fats, &c., and alkaline bodies which may play the same part as potassa. Such alkali may also be able to act in other media as it would in an alcoholic solution.

The question remains still open whether the activation of oxygen by hydrogen is the sole or the main mode of such activation in organisms?

Nencki replies to this question in the negative, and Schmiedeberg puts forward a new hypothesis of physiological combustion, regarding the assumption of the origin of active oxygen in the organism as needless, and calling attention to the influence of the tissues upon the bodies undergoing oxidation. From Schmiedeberg's experiments it appears that within the tissues oxidation proceeds much more rapidly than without them. Prof. Radziszewski, however, remarks that—

1. If we pour into a narrow test-tube a luminous solution of lophine it is most brilliant where it touches the glass, and here the oxidation is strongest. The condensation of gases, and consequently of oxygen, upon the surface of solid bodies, which is still more marked in capillary tubes, has a favourable influence upon the rapidity of oxidation.

2. When fluids come in contact with each other in very narrow openings, slits, &c., there arise electro-capillary currents.

The author refers here to the experiments of Becquerel, who proved that sodium sulphide and copper sulphate, on meeting in very narrow slits, formed not copper sulphide, but metallic copper.

Whether oxygen, dissolved or in unstable combination when passing through capillary vessels, may, under the influence of the electro-capillary current, be capable of causing phosphorescence can only be proved by further experiments.

Some of the above questions having a direct bearing upon phosphorescence were studied by the author during the spring of 1881, at the Naples Aquarium, where he had the opportunity of examining several hundred specimens of *Pelagia noctiluca*, *Beroe ovatus*, &c.

The results of his experiments may be summed up as follows:—All the animals examined had an alkaline reaction, but the base which occasions this alkalinity could not be isolated. From the purified alcoholic extract of *Pelagia noctiluca* he succeeded once in obtaining a precipitate with gold chloride, but it underwent decomposition during re-crystallisation. The luminous substance of *Pelagia noctiluca* is evidently a fat. The residue from the evaporation of 180 specimens of *Pelagia noctiluca* was extracted with ether, and yielded a body having the following properties:—It is a syrupy, slightly yellowish, neutral liquid, easily saponified by alkalies. If kept for some time under the exsiccator it becomes harder, and almost assumes the consistence of butter. It is sparingly soluble in alcohol, readily in ether, but absolutely insoluble in water. If mixed with neurine or potassa this fat gives, when shaken, phosphorescent flashes. Living specimens of *Pelagia noctiluca* behave in the same manner. In the Lazulite Grotto, in the Isle of Capri, the author saw thousands of specimens floating upon the surface of the sea. When undisturbed they were not luminous, but if excited by throwing them from the one hand to the other they gave off phosphorescent flashes, similar in colour and intensity to those obtained from the fat above mentioned.

Finally, to prove the presence of active oxygen, the author used plates of plaster and clay, burnt and soaked in potassium iodide and starch-paste, tincture of guaiacum, &c. As Panceir had proved that the epithelial cells are the seat of the luminosity, either the entire animal or the luminous surface, prepared as quickly as possible, was laid upon the plates. The results were in every case affirmative. It must, however, be mentioned that the well-known colour reaction was produced most distinctly at the margin of and beyond the contact surface of the animal body, and were fairly visible at those parts of the plate which were in direct contact with the body.

III. DIETETIC REFORMS.

WHETHER owing to the intensified struggle for existence or to the struggle for notoriety, our food and drink are now being scrutinised with abundance of learning, but too often also with a plentiful lack of common sense and practicality. Most of the reformers agree in telling us that the table habits of our forefathers, as well as of ourselves, are entirely wrong; but when they pass from negation to affirmation the doctors differ to an alarming extent.

Some time ago the so-called Temperance Movement—the condemnation and rejection of alcoholic beverages—seemed a sufficiently startling innovation. But now liquids which the original teetotallers imbibed without scruple are called in question, and denounced as little better than beer or spirits. Tea and coffee are especially obnoxious to the innovators. We are told that to their use is owing—in part at least—that increase of nervous affections which overcloud modern life.

In a book which lies before us it is stated that "we should never take fluids with our food, but make it moist with the saliva, masticating it thoroughly, and enjoying the taste. If we moisten it with drinks the saliva will not come so freely, and in this way we lose one of the best helps to digestion."

A breakfast is then described upon the reform principle. "So we began our breakfast, Edith and I, each with a great luscious peach, the last of which we cut into a cup of bread and milk. Then with the green-corn omelette came a dish of stewed green grapes. They were as pink and racy as stewed pie-plant [?] or green currants, and decidedly appetising." Now this might doubtless be a very pleasant breakfast, but, except in warm climates, it is within the reach of the "upper ten" only, and even for them not at all seasons of the year. Peaches preserved in tins are often deficient in flavour, and their acid juices—like those of all fruits—are certain to act upon the tin-plate and solder, extracting therefrom a dose of lead. Hence we must pronounce this breakfast, for England at least, an impracticability. Tea and coffee are certainly open to grave objections; but they can be stored for use, and obtained in all seasons and in all climates, and render the use of certain solids possible which would have otherwise to be set aside. Banish tea and coffee, and bread and butter follow them,—not perhaps a grievous loss, considering of what modern butter is composed.

Another authority recommends for breakfast "simple vegetable food, which must have thorough mastication. No drink during the meal or immediately afterwards." We might here ask how many kinds of vegetable food, obtainable at all times of the year, are sufficiently juicy to be got down without accompanying drinks in the short interval of time which modern industrialism allows for meals? The factory-worker may take with him in the morning his coffee or tea and sugar in a can, and at breakfast-time can easily obtain a supply of boiling water; but imagine him having to cook a breakfast of cabbage, turnips, or carrots! Or suppose his wife having to prepare such a meal in the morning, and send it to him to the workshop without its becoming cold! Even in much higher positions of life a vegetable breakfast would not be obtainable without great disarrangement of the household. At most hotels the traveller would be advised to seek his reformed breakfast elsewhere.

In short, before the opponents of tea and coffee can expect to make much headway, they must find some substitute equally convenient and capable of fitting in with the wants of the times.

It must not be forgotten that long before tea and coffee made their appearance in Western Europe breakfast was not a dry meal. The bread and beef of the fifteenth and sixteenth centuries were washed down with a tankard of ale. The oatmeal porridge of the North of England and Scotland, regions which certainly reared in the olden time a hardy and eupeptic population, was in itself a very moist food, and was accompanied by milk or buttermilk.

But milk itself no longer passes unchallenged. We are told that it may very possibly contain the germs of tubercular disease, and that, if it has been diluted with water from some well guilty of cesspool contamination, it may introduce typhoid fever into our families.

We go back to the dietary scale proposed by the medical man who recommends a vegetable breakfast. For dinner he allows "Plain meat, with bread and one vegetable. No dessert and no drink." For supper, "Bread and butter, with a little fruit." Elsewhere he writes:—"The vital question of food, of plain food, plainly cooked and eaten in moderate quantities, they dare not mention unless to ridicule it." And again:—"One of the great table errors is excess in quantity. And this comes in part from too great variety."

There is in these passages much that cannot be allowed to pass unchallenged. Experience has taught us to dislike the word "plain," and those who use it in a laudatory sense. A "plain man" is generally one who turns up his nose at truth and beauty, and thinks that all human duty is summed up in money-getting. "Plain cookery" we have always found to consist essentially in taking good materials and converting them into at once the most costly, the most indigestible, and the most unsavoury dishes.

"Excess in quantity" cannot in these days be a general table error. If we look at the rates of wages and salaries, and even of profits in the smaller businesses, and compare them with the current prices of the most necessary articles of food, we shall see that for the many the sin of gluttony is rendered physically impossible. In England, at least, we must strangle—metaphorically at least—the hordes of salesmen, middlemen, and rings which have forced themselves in between the producer and the consumer, before the workman, the clerk, the small tradesman, and the less prosperous professional man will be in serious danger of over-feeding. And is excess in quantity likely to spring from variety? Surely not. Savoury food, not affected with "plainness," is eaten slowly and thoroughly masticated, so as to enjoy its flavour, and is thus thoroughly insalivated and readily digested. "Plain," monotonous food is bolted in lumps, by way of despatching an uninteresting business. The unfortunate eater, as in the case of cold meat, is apt to "cut and come again" in the vain hope of meeting with some approach to a flavour. Or possibly he flies to pungent irritating condiments, salt in unreasonable excess, pepper and mustard, and red-hot pickles. An unnatural thirst is thus created, which is allayed, if possible, by floods of stout and bitter. So, for a thorough dietetic reform, we must begin by proclaiming war against plainness and monotony, fiery condiments, and bolting,—all cardinal sins of the English *cuisine*, and of the habits which it has induced.

We have long ago heard it maintained that especially in a cold, moist climate, like that of Britain, thirst is so far an artificial appetite that a man does not require to drink if his food is properly selected. To some extent we can confirm this view from our own experience. But the meals at which drink was thus felt to be unnecessary were not built on the above-quoted lines of "plain meat, with bread and one vegetable," and included at least six kinds of vegetable matter, most of them very juicy.

But the dietetic innovators with whom we have so far had to deal, however much they may seek to abridge our repasts in quantity and variety, do not prescribe animal food. This undertaking is left for a body of men who are known as vegetarians, and whose experiments on a superficial examination seem to be based upon scientific truths. On closer and impartial investigation they are found, however, to be mainly fallacious.

We may survey these arguments as summed up in the "Science Monthly" by Dr. T. L. Nichols, who seems to us to expound rather than to advocate the vegetarian creed. He writes:—"If it were a question of economy of feeding, that would be easily settled. There is no doubt that *any given territory* will sustain from six to ten men on fruits, grains, and vegetables, to one on flesh. The oatmeal which, converted into pig, will feed one man, will give a purer and more sustaining diet to fourteen in its original condition. Dense populations must of necessity live mainly on the unchanged products of the vegetable kingdom. In tropical climates it has been found by experiment that an acre of land planted with the banana would feed twenty-five—Humboldt says thirty—persons. In England we think each mouth must have its acre."

The fallacy here lurks in the words which we have italicised—"any given territory." Take a plot of fruitful ground, in a genial climate, capable of being fairly drained, and liable neither to prolonged drought nor to capricious inundations, and the Vegetarian contention is true. Such land will doubtless support from six to ten times as many men if devoted to agriculture as it could if given up to grazing purposes. But unfortunately there is abundance of land which will grow grass, though it will not produce fruits, corn, or vegetables. Hence it can only be utilised as grazing ground, and under a Vegetarian *régime* it would have to be abandoned.

Such, in Britain, are the moorlands and mountain-pastures of Wales, Cumberland, and the North of England. The shallowness of the soil, the difficulty of access, and the severity of climate consequent upon the height above the sea-level, render these tracts utterly incapable of cultivation. But for grazing purposes they are not without value. We may take, again, low-lying districts, marshes, and the like, liable to be overflown. No one cares to plant crops which he may lose by a sudden rising of the waters. But they are available for grazing, as cattle may be driven for safety to higher grounds in case of a flood. Or let us take the celebrated Vale of Aylesbury, with its rich, deep soil,—unfortunately, from the scanty slope of the soil, difficult to drain. Here you may march for mile after mile and see nothing but grass ; grass, everlasting, monotonous grass. The natives will tell you that crops do not pay as well as grazing. Indeed, since the present fit of cold, wet summers set in, landowners and farmers, England over, are being advised to convert their available lands into permanent pasture.

In warmer and drier climates, such as the Cape, Australia, &c., the possibility of severe and prolonged drought discourages farming, properly so called, and encourages sheep-breeding. Thus the world over we shall find, on taking a fair average, that if we should by adopting the Vegetarian system gain on one acre of land, we should lose on another.

But there is another item in the account which Vegetarians overlook. So long as man consumes a mixed *régime* he derives no trifling part of his sustenance from the sea, and this portion it is generally considered is capable of indefinite increase. Are we to sacrifice the Fisheries in deference to Vegetarian scruples ? If so, the question of "economy of feeding" will soon be settled, though in a different way, from what dietetic reformers fancy.

Elsewhere we read—"Vegetarians point to the striking fact that the animals most nearly resembling man, anatomically and physiologically, and to which he is supposed to be most nearly related by descent, live on fruits and other vegetable substances. Anatomists and naturalists declare that man is frugivorous. Primitive man is supposed to have lived on fruits and nuts."

Here also is a strong admixture of error. The monkey tribe undoubtedly form the closest approach to man, both morphologically and physiologically. But along with fruits they feed upon insects, eggs, and probably small birds.

Modern anatomists and naturalists know that the habits of an animal cannot always be deduced with unerring accuracy from its structure. How close, *e.g.*, is the resemblance between the digestive organs of the rabbit and of the rat. Yet the rabbit is, as far as we know, purely phytophagous, whilst the rat is partly carnivorous, and attacks or kills other animals to obtain animal food.

How man first adopted a mixed diet is of course a difficult question. Perhaps the anthropoids from whom he has descended had already taken this step. It is, however, well to remember, as several travellers have pointed out, that cannibalism is generally to be found where animal food is wanting.

We are told that "Eminent authorities like Sir Henry Thompson, Dr. Richardson, Mr. Buckmaster [*sic*], &c., have asserted the sufficiency, the purity, the healthfulness of a vegetarian diet; the only question is whether there may not be some benefit in an admixture of animal matter,—a moderate proportion of flesh, fish, milk, butter, cheese, eggs. Even the so-called Vegetarians make use of eggs, and milk and its products, thus drawing a portion of their sustenance from the animal kingdom. Their excuse for this apparent inconsistency is that milk is not flesh, but simply vegetable —elements gathered and stored for the calf until it can gather its own; while the egg, with the exception of microscopic germs, is not animal but vegetable matter, mostly albumen, stored up to feed the future chick."

We have often been struck with the inconsistency—not apparent, but very real—of the Vegetarians in making use of milk and eggs; but never before have we met with this excuse,—a plea which for effrontery is unmatched in the annals of controversy, and which it is difficult to pronounce other than dishonest. How the secretions of animals can be simply vegetable must be incomprehensible, unless animal and vegetable are synonymous terms, in which case of course the Vegetarian question falls to the ground as devoid of meaning. The idea of "vegetable matter" being stored up to feed the future chick will appear very strange if we reflect that the newly-hatched young of most birds, even such as in their adult state are purely frugivorous, are fed upon an animal regimen!

The dietetic reformers promise man length of days. Would it not be wiser if they strove to amend the quality rather than the quantity of life? We would also beg them to consider whether the dyspepsia, nervousness, &c., which they seek to combat by "severely plain living" are not mainly due to overwork under the pressure of anxiety?

IV. THE CRISIS AT THE BRITISH MUSEUM.

By R. M. N.

FEW naturalists, I apprehend, can now traverse Great Russell Street without a sigh and the exclamation "*Fuimus Troes.*" For them the British Museum is in one sense a thing merely of the past. Perhaps now the revolution has been consummated, and now there is little hope of its reversal in the lifetime of this generation, I may be permitted to attempt a brief and impartial survey of what the public has gained or lost by the recent changes.

Every reader of the "Journal of Science" will doubtless know that the British Museum has been, from its very outset, of a heterogeneous nature. Though under the control of one and the same governing body, it consisted in reality of three distinct institutions, very unequally yoked together, and not too amicable among each other. There is, first, the great National Library; secondly, the Collections of Antiquities and Works of Ancient Art; and lastly, though in my opinion of infinitely highest importance, the Natural-History Collections.

Between these three departments there has always been a rivalry for working funds, and latterly for room. In both these respects the Natural-History Department generally came off worst. Scientific men have often had to feel disgusted at seeing money lavished on ancient manuscripts whilst important palæontological specimens were secured by private collectors or by rival establishments abroad. On this point I need, however, say the less, as I am not aware that the recent changes extend to the appropriation of funds.

There remains the great question of space. The growing extent of all the collections demanded more room than could possibly be provided in Great Russell Street. One of the departments must therefore be removed, and unfortunately, and as I hold most injudiciously, the lot of banishment fell upon the Natural-History Department. The removal of the Library, indeed, to some remote suburb would have been nothing short of a national calamity, and I can only hope that such a step may never be seriously proposed; but the transportation of the Antiquarian Department to South Kensington would have been more rational than that of the

Natural-History collections. The Elgin marbles, &c., being almost exclusively examined by students of the Fine Arts, would have there been in place. In short, the South Kensington Museum being devoted to objects of the Arts, a further collection of the same nature would have been "like to like." Why should the art-student be compelled to make a pilgrimage to Great Russell Street, instead of finding in some one spot—be it South Kensington or elsewhere—all the objects he might wish to study concentrated for ever? I hold, in short, that all the Art collections, now scattered abroad, should be assembled in one locality, even if their different arrangements should prevent them from being united in one grand Art Museum, a London Louvre. Had this been done the Natural-History collections might have found ample space in Great Russell Street for many years to come.

Again, even supposing that these collections should ever require removal, surely a more suitable locality might have been found than the one to which they have been consigned. The arguments to this effect are so exceedingly plain and cogent, and have been so often put forward, that I should feel ashamed of once more repeating them save for the circumstance that they have never been met, save with the "conspiracy of silence." Surely all persons possessing the least residue of common sense will grant that the first essential for the site of any public office or institution is centrality, or the nearest practicable approach thereto. It must further be admitted that the need for such centrality is more pressing in a large city than in a small one, and in London strongest of all. If this condition is overlooked the inhabitants of some one district are favoured at the cost of the majority. This principle is admitted and acted upon as regards public buildings for other purposes. When, *e.g.*, it became desirable to provide better accommodation for the courts of justice, and to collect them together in one spot, no such considerations as cheapness of land, abundance of space, and scope for architectural display were entertained as arguments for removing the law-courts from Westminster to some remote suburb. Had the suggestion been made it would doubtless have been dismissed as not worthy of a serious consideration. Why, then, should the case be different as regards a Scientific Institution?

It may, indeed, be said that by means of the District or the Metropolitan Railways we may be carried from many parts of London, and put down—in the absence of explosions—at a spot very near the new Natural-History Museum.

But a majority of people do not live near these railways, and have in consequence first to take a journey by omnibus, tram-car, or by some other railway, losing more or less time at each change. I have calculated to what extent I am the loser by the alterations in question. Admitting that Great Russell Street is not the most central locality conceivable, and premising that I do not live very near the old Museum, I was able to reach it in less than an hour; but after trying and comparing various possible routes, I find that it takes me an hour and a half to reach the new Museum. Thus on the double journey there is the clear loss of an hour, taken, be it well remembered, out of the best part of the day. Nor is my case at all singular; I have compared notes with others who, like myself, are interested in the study of Natural History, and I find that they all experience a loss of time, greater or smaller, according to the spot where they happen to live.

There is here a further and a no less important consideration: the new Museum stands quite isolated. Whoever wishes to visit it must undertake a special journey for that purpose; he cannot intercalate it among a round of other places where he has to call. Now with the old Museum this was not so; a man wishing, *e.g.*, to compare some specimen which he had received with the nearest approaching forms known could call there in passing, without the formality of a special journey.

It must also be remembered that South Kensington is a "locality" for the wealthy only. Students and men more advanced in life, who devote themselves to the commercially barren task of scientific research, can scarcely be expected to take up their abode in so expensive a quarter. Even if they did so they would thereby be deprived of convenient access to the British Museum Library and to other means of study. This separation of the Library from the Collections is in many cases inconvenient, both for the public and the officials. It is beginning to be found that a special library of Natural History will be needed for the use of the latter, —of course at considerable cost and not without difficulty, since many of the most important works of reference are out of print.

What may be the motives which, in the face of these considerations, moved the powers that be to this great revolution I have never been able to learn. I find the step referred to with approval by the organs of official Science and in certain published speeches; but could the question of removal to South Kensington have been submitted to a *plebiscite* of

Naturalists, it would, I am sure, have been negatived by a large majority.

There is an innovation, not peculiar to the British Museum, to which I cannot help referring,—the introduction of "refreshment rooms." This feature seems to me, to say the least, utterly needless. Few persons remain in a museum longer than four or five hours at a time, and I am heartily sorry for those persons who require food and drink at shorter intervals. This matter is intimately linked with one of the unsettled questions of the day—the opening of museums, galleries of art, public libraries, &c., on Sundays. I am by no means certain that such opening is demanded by any large portion of the public, or that it would be productive of good if carried out. But by connecting museums with refreshment rooms the advocates of Sunday opening should reflect that they enlist against themselves the sympathies of that large, well-organised, and earnest body who now demand the total suppression of the liquor traffic on Sundays.

Furthermore, it may well be asked whether it is wise in places devoted to study to supply the means for alcoholic excitement and for possible disorder. The refreshment room will attract not students, but loungers, and induce them to stay longer than they otherwise would, and to appear in their least desirable aspect.

V. THE IMPORTANCE OF INSECT-CAPTURE FOR DROSERA ROTUNDIFOLIA.

By H. M. Busgen.

THE existence of so-called carnivorous plants, fitted with special but varied appliances for capturing flies and other small insects, is now no longer disputed. The more closely the vegetable world is studied from this point of view, the more of such fly-catching species are discovered. A recent instance is the common Petunia, so long a favourite in our gardens. Numbers of florists and others must have noticed little gnats, &c., sticking fast among the minute hairs on its leaves. But till lately this fact was considered a mere accident, of no importance in the economy of the plant. Whether our zoophilists will on this account banish the Petunia from their gardens it remains to be seen.

Nor is the mere capture of insects by plants the only point thus recognised. It is fully established that the little prisoners are made to undergo a kind of digestive process. Their bodies, whilst adhering to the flowers or leaves of their captors, are liquefied, and appear in that state to be absorbed into the tissues of the plants.

But a third question has been left to some extent open. Do the insects thus caught promote in any way the well-being of a carnivorous plant? Would it flourish as well—or perhaps better—without insects, or any equivalent animal matter, as with them? On this important point botanists of eminence are by no means at one. Comparative experiments made upon the influence of a supply of white of egg have given fluctuating results. Some of the observers have found the plants thus fed decidedly benefitted as compared with other specimens from which such diet was withheld. Other experimentalists have been unable to perceive any difference; and others, again, have even reported injury,—the plants being apparently the worse for the absorption of animal matter.

Results so diametrically opposite can be explained only on the assumption that the initial conditions of the plants selected for experiment must have been dissimilar. Further investigations were therefore needful, in which all sources of error should be eliminated. H. Busgen has endeavoured to secure a perfect uniformity by beginning his observations with the germination of the seed.

The experiments were made upon the Sun-dew (*Drosera rotundifolia*), and the results are more immediately applicable to this species alone. The seeds of this plant are so light that a hundred weigh only 2 milligrammes, and a single seed only 0·02 milligramme. Differences in the dry weight of single seeds could therefore be safely neglected, and the weight of the dry seed obtained at the end of the experiment from the fed and the unfed plants respectively could be taken as an accurate expression of the results.

Ripe seeds of the Sun-dew were therefore collected at the end of October, 1880, and were kept in a cellar through the winter. Part of them were sown at the end of January, in a glass case, upon a piece of peat which had been previously boiled in water. In May the seeds germinated, and by June 22nd there were so many plants of equal size that the feeding could be commenced. A loose piece of peat was cut smoothly in two, parallel to its longest surfaces, and boiled for half-an-hour in a culture-solution at 2 per 1000 (50 parts potassium nitrate, 20 of calcium sulphate, 10 of magnesium sulphate, and 5 parts of sodium chloride). When cold, eighteen young plants which had just put forth their first leaves were set upon each of the pieces of peat in three rows. The peats were laid upon plates filled almost up to the upper edges with the same solution, fitted with gauze covers, and placed in a window with a south-east exposure. On June 22nd and 28th, July 1st, 6th, 12th, and 22nd, in the beginning and the middle of August, and in the middle of September, all the leaves of the one series which showed a sufficient secretion were supplied with larger or smaller Aphides, corresponding to their size. Every day the plates were filled up with distilled water to make up for the loss of evaporation, and from time to time the plants were carefully freed from Algæ.

On July 22nd, four weeks after the commencement of feeding, the eighteen plants which had been fed had ninety leaves, and the eighteen which had not been fed ninety-five. The greater number of leaves of the unfed plants showed that those selected for this series were in the beginning the more advanced. But as regards the strength of the plants and the size of the leaves the fed plants had already the advantage.

At the end of October the leaves faded. The plants were placed in a cold frame, looked over every fortnight, and supplied with water as it was needful. At the end of April they were cleaned. On May 5th, when feeding was recommenced, fifteen fed plants had together 126 leaves, and sixteen unfed plants 96 leaves. All the fed plants showed a vigorous growth; of the unfed ones two only appeared equally strong. The remainder were partly about half as strong, or still feebler. Still all were apparently healthy, and their glands secreted in the normal manner.

Corresponding to the increased strength of the plants and the larger diameter of their leaves, each leaf of the "fed" series was now supplied on the average twice weekly with a larger number of Aphides. The time of feeding was regulated according to the weather, selecting such as seemed favourable to the capture of insects and to the secretion of the glands.

During the summer blossom-heads appeared upon both series, and by July 26th the seed-capsules were ready to be gathered. The following figures will show the results:—

14 fed plants yielded 17 heads of blossom, whilst 16 unfed plants produced 7. The 14 fed plants had 90 seed-capsules, the 16 unfed plants only 20. An enumeration of the leaves could in this stage be no longer of importance, but a superficial census showed on 14 fed plants 194, and on 16 unfed plants 222.

Of the thirty-six plants with which the experiment was begun there died altogether six, four fed and two unfed. If we are unwilling to ascribe this proportion to accident, it still does not affect the result. If, in nature, the number of the plants which die yearly is increased by the consumption of insect prey, this loss is covered by the more luxuriant fructification of the survivors.

The last doubts as to the benefits of feeding in the case of *Drosera rotundifolia* were removed by a determination of the total weight of the plants when dried. The figures were:—For the fed plants 0·352 grm., for the unfed ones 0·110. The solid matter absorbed by the latter in the course of their development amounted therefore only to 33·8 per cent of that assimilated in the same length of time with the aid of animal food.

Herr Busgen has carried out several other series of comparative experiments in which the conditions of nutrition were less favourable. Thus to one series of plants there was given, instead of the culture-solution, spring water and distilled water: in the second series there was used a liquid containing potassium chloride in place of potassium nitrate; the results were, however, similar to those already given.

In a communication to the "Botanische Zeitung" Herr Busgen summarises the results of his investigations as follows:—We must regard it as demonstrated that the organism of *Drosera rotundifolia* is supplied through its leaves with animal matter which is of great importance for the development of the plant, and especially for its fructification. The necessity of this method of nutrition for the preservation of the species could only be proved by the cultivation of several successive generations. Its demonstration would, however, present little especial interest. The demonstrated advantage of the fed plants as compared with those not fed is sufficiently striking to make the arrangements for this purpose intelligible.

There can be little doubt that similar results would be obtained on careful experimentation with other insectivorous plants.

VI. FLORIDA.

By W. D. Gunning.

ON Palm Sunday (*Pasqua Florida*) of the year 1512 Ponce de Leon discovered the peninsula which forms the eastern boundary of the Mexican Gulf, and named it after the day *Florida*. For many years the name covered what are now the Carolinas, North and South, and a portion of Georgia, Mississippi, and Louisiana.

Florida is the youngest portion of North America. It lies along the trend of the Appalachian Mountains, whose axis is the archæan granite. A few months ago, in boring an artesian well at Gainsville, this same granite was struck. We may assume that it underlies the whole peninsula, and is the foundation on which the coralline structure was built. Florida is a succession of coral reefs. Geologically it is young, as all the fossils are of living species.

As the peninsula nowhere rises more than 250 feet above the sea, its features are simple and monotonous. The rivers could not sculpture the face of the land into valleys or canyons. The bane of the high table-land on our Pacific slope is over-drainage; the bane of Florida is *under-drainage*. The Colorado dashes wildly through a gorge of its own cutting, 5000 feet deep. The Saint John flows sluggishly in a channel barely deep enough to carry its face below the bounding marsh or "scrub," or pine-land. A result of this under-drainage is an immense acreage of swamp-land.

While in the geologic calendar Florida bears the date of yesterday, its flora and fauna are ancient. The *Tapodium*, known as the Bald Cypress, is the largest tree on our Atlantic slope. A fact of deep interest is that this cypress stands in close relationship to the *Sequoia* of California and *Glyptostrobus* of Japan. The *Sequoia gigantea* is restricted to a few isolated patches in the Sierras. The *Tapodium distichum* grows on the swamps and on the low river-banks of our Southern Atlantic States. *Glyptostrobus*, *Sequoia*, and *Tapodium* have descended from a common stock. Their geographical distribution is evidence of great antiquity. Their divergence in botanical structure and habitat—*Sequoia* adapting itself to an altitude of 6000 feet, and *Tapodium* to marshes at the sea-level—is evidence that the dispersion occurred long ago.

Another tree of historic interest is the *Torreya.* Only four species are found; one in China, one in Japan, one in California, and one in Florida. The *Torreya Californica* is rare in California. We have found it only in the Yosemite, although it occurs in other parts of the State. The *Torreya taxifolia* is restricted in Florida to a district not more than 10 miles long, on the banks of the Apalachicola. This ancient genus is moribund.

On the "Keys" the flora is tropical. The Keys are coral reefs just emerging from the Atlantic. Those which are least advanced support no growth but the mangrove. The seed is borne on the tide from adjacent land, and its mode of growth is such as to give the tree anchorage to the coral. On the low Keys, called the Thousand Islands, the mangrove attains a height of 60 feet.

The mahogany has held a place in the list of Floridian flora, but it grows only on Umbrella Keys.

Gummifera might be written as the specific name of many shrubs and trees of Florida. *Bursera gummifera,* called "gumbo limbo," is most prolific in gum. The *Ficus aurea,* or wild fig, exudes a gum something like india-rubber.

The Sive oak is abundant, but is often dwarfed. The red cedar attains its highest excellence on Cedar Keys, where it is cut for the pencil-factories of the north. It is the *Bermudiana,* a variety of the *Juniperus Virginiana.*

The pitch and yellow-pines occur everywhere except in the swamps. The *Sabal palmetto* is anywhere except on the high pine-land.

A peculiarity of all Florida trees growing in wet or boggy land is a bulging out of the trunk near the ground. It is most striking in the bald cypress, and least noticeable in the oaks.

The herbaceous flora is rich and varied. I have seen the face of the earth saffron-coloured from a carpet of *Polygala nana.* I have seen a roadside fringed with that beautiful orchid *Pogonia.* Perhaps the most highly specialised plant in the State is the *Sarracenia variolaria,* introduced to the botanical world a few years ago by Dr. Mellichamp, of North Carolina. It is carnivorous, and as a fly-catcher it is excelled only by its cousin, the *Darlingtonia* of California.

The fauna in mammalian types is poor; in reptiles, birds, and insects it is rich. The alligator is common, and the true crococile has been found, although it is rare.

When Florida came under the eye of history she supported a tribe of Indians, the Seminoles, who had made a little advance in agriculture. A remnant of this tribe still lingers on the skirts of the everglades. The Seminole knows nothing of the shell-heaps which abound on the banks of rivers and shores of the sea. They are memorials of an older race. In the oldest shell-mounds no pottery is found. Only a few implements have been discovered, and these were wrought of shell and bone. Bones of animals killed for food are rare. The people who made these mounds had not learned the arts of agriculture. They lived almost exclusively on mollusks and fishes. Florida sustained her primitive man on an exquisite climate and the product of her waters.

Ponce de Leon and his men brought with them oranges from Seville. The seed dropped on the Spanish camps found a better climate than they had left. Orange groves sprang up in the footprints of the Spaniard. In the absence of cultivation the trees lapsed. Perhaps no neglected fruit reverts to a state of nature more rapidly than the orange. Now and then it lapses into a primitive state. The orange is a berry with a leathery rind. Farthest from the berry is the achene. This is a small, dry, indehiscent fruit; its typical form may be seen in the buttercup, which, in structure and colour, is a primitive flower. Now the orange is occasionally found to lapse toward this early, apocarpous condition; the segments partially separate, and a leathery rind encloses each segment.

The Spaniards made but little out of Florida. The English, who followed, made no more. They ceded the peninsula back to Spain, and in 1820 Spain ceded it to the United States. We fought the Seminoles, cultivated a little cotton and cane, and raised cattle of little worth on worthless grass. In our civil war attention was directed to the orange. In antebellum times, only here and there, a man more enterprising than his neighbour had cultivated this fruit. The only variety known was the Florida seedling. It is a choice orange, but it is only the old Seville modified by climate and culture.

The State is gaining rapidly in population and wealth. Orange growing has become a great industry. The promised gains have lured Swedes in colonies, and English and French and Germans in individuals.

These words may fall under eyes bent on Florida, and to be helpful we must be specific :—

First.—Only a small portion of Florida is fit for the growth of oranges. Choose the richest soil you can find, and be sure it has a clay sub-soil. You will find no *rich* soil in the State, unless it be under water.

Second.—Bear in mind that oranges are coming under the law of other fruits, and will be sold as *varieties.*

Third.—You may reasonably infer that if the environment in Florida has improved the Seville, it may improve other and choicer varieties. Experiments are confirmatory. The best oranges grown in Europe are the Jaffa, the Malta oval, the Majorca, and the Mediterranean sweet. Each of these varieties, when grown in Florida, has improved in flavour or other qualities. The Jaffa, as grown in Jaffa, does not keep. It deteriorates before it reaches London. Grown in Florida it can be taken in the best condition to the northern markets or to London.

Fourth.—In the light of these facts you will select for your grove the best sports from the Florida, as the Magnum-bonum and Homasasa, a few Mandarines, and the best varieties from Europe. Select your trees carefully, fertilise judiciously, cultivate every spring and summer month, and in five years you will have an income. When your trees are in full bearing you will have from 500 to 1000 dollars an acre.

If you have located well to the south, cultivate the lemon. Villa Franca is the best variety. Pineapples may be grown as profitably as either oranges or lemons.

Do not heed the cry of over-production. In 1850 the value of fruits grown in the United States was 7,723,600 dollars; in 1880 the value was 50,873,150 dollars. In these figures we make no account of what was consumed by the grower. Our population within thirty years has increased threefold; the consumption of fruit has increased sevenfold.

It is a great misfortune that the Spaniards who dropped the seeds of their orange did not drop a few seeds of their Cuba grass (*Panicum jumentorum*), or the Sorgum grass (*Sorgum halapense*). "Man cannot live on bread alone," neither on oranges. Flocks must give him of their milk and feed him of their flesh; herds must have pasturage. The crying need of Florida is *grass;* her native grasses, *Chloris floridana* and *glauca, Panicum fuscum* and *striatum,* and a few species of *Paspulum,*—all known under the general name of Wire-grass,—are of little worth. Both Cuba grass and Johnson grass, if generally introduced, would give the Floridians good milk and palatable beef.

Health they have, and a climate superior to any other in the western world. Florida is on the border of the torrid zone; she lies within lines of latitude which would give her rank as one of the hottest portions of the globe; but she is a *peninsula*, and is swept alternately by winds from the Atlantic and winds from the Mexican Gulf: heats which would otherwise scorch her are mitigated. In summer the thermometer never rises as high as in the Northern States, and in winter it seldom sinks to 40° F. The characteristic is mildness and uniformity.

Winter life amid the balsamic odour of the pines is simply delightful. The skies are of softer blue than those of Italy. Birds of rarest plumage seek the lakelets, and a bird of many songs mocks from pine and orange, and even the trellis of your verandah every throat that warbles; and Florida seems an eternal *Pasqua* Florida—a Palm Sunday.

Washington, D.C., U.S., October 20, 1883.

VII. SENSIBILITY TO LIGHT AND COLOUR IN EYELESS AND BLIND ANIMALS.

ACCORDING to the present state of our knowledge it is beyond doubt that light, *as such,—i.e.*, unaccompanied by radiant heat, has an effect upon animals not merely by means of the organs specifically developed for its perception. It produces physiological changes of greater or less intensity in its passage through the skin, or through the body in general. For a closer investigation of this latter action of light—the "photodermatic"—experimental investigation has not been confined to eyeless species, but parallel researches have been made with blind animals. Hitherto most of the experiments upon the action of light upon eyeless and blind animals have been confined to the influence of rays of different colours and intensities upon the development of the animals in question. Prof. V. Graber, however (in the "Sitzungsberichte der Wiener Akademie" for 1883, p. 201), has raised the question whether, and to what degree, eyeless and blind animals are sensitive to differences of light, and manifest this sensitiveness by moving towards or away from the light.

The number of the animals thus tested was as small as possible. The experiments were confined to one representative of the normally eyeless groups,—namely, the earthworm,—and to one representative of a blind animal, for which purpose the common water-"newt" (*Triton cristatus*) was selected.

As regards the eyeless animals, the experiments, of which the author gives a brief abstract, are not of such a nature as to render further exact investigations needless. For his experiments on earth-worms he used a box consisting of perfectly equal and similar compartments or cells. The front and back of the box consisted of panes of quite clear glass, puttied water-tight in the framework. The latter was further provided with grooves for the occasional introduction of panes of glass and bottles with parallel sides. The cells had each a separate cover, and could be separated from each other by perpendicular slides. By introducing two slides the box could be divided into three compartments, each of which had two front and two back windows. The latter, however, were covered, so that the light was admitted merely from the front. The bottom of each cell was covered with mud, but in so thin a layer that the worms could not hide themselves in it. For obtaining different degrees of light the two windows were used, one being uncovered and the other darkened by the introduction of a slip of wood, or both were fitted with media of different colours.

The experiments were conducted in the following very simple manner:—At the beginning of each experiment a considerable number of worms (20 to 30), just dug up, were placed in each compartment, and were distributed as equally as possible over the entire surface. The box was placed at a window having a northerly aspect, and at regular intervals—in general every hour—the number of specimens in each of the differently lighted cells of each compartment was taken. The worms were then again equally distributed, and at the same time the position of the light-absorbing media was changed. From time to time, generally every four hours, the worms were removed, and fresh ones were substituted.

The first experiment consisted in leaving these animals the choice between a relatively light and a comparatively very dark compartment. In seven enumerations there were found in the light compartment 40 worms, and in the dark one 210. The proportion of these two numbers, the "quotient of reaction," is therefore 5·2. It may be asserted without any doubt that a strong light is very unpleasant to worms. But these animals react not merely with such great differences as existed in the above experiment, but with very slight distinctions. If the experiment was so modified that the one window was of clear glass and the other of milky glass, there were found in the light compartment 204, but in the darker one 326, or a majority of 122. Though this difference is not very great, Prof. Graber considers it allowable to infer that earth-worms are capable of recognising the difference, and would even be able to react upon far smaller variations in the intensity of the light.

In the following experiments on the sensitiveness of earth-worms to qualitative differences of illumination the coloured lights employed were selected of equal intensity, in order to eliminate the influence of different intensity which has been shown above. As this is difficult to carry out in practice, the experiment was so arranged that in each pair of colours first the one and then the other was selected much the lighter. After it had been proved that the earth-worms were attracted by red, but repelled by blue, in all subsequent experiments the blue was chosen much darker than the red. In twelve enumerations there were found in the light red 193, and in the dark blue only 57 worms, so that the red blue quotient = 3·4. If we consider that, as far as the intensity of light is concerned, the worms would give the blue compartment the preference, it is fully proved by these experiments that these animals are exceedingly sensitive to qualitative differences of light.

A comparison was next instituted between ordinary white light and white light from which the ultra-violet rays had been eliminated by a passage through carbon disulphide. In five enumerations there were found in the white free from ultra-violet 87 worms, but in the ordinary white light only 13, the quotient therefore being 6·6. Worms, therefore, seem to have a strong dislike for the ultra-violet rays.

A comparison between light green and dark blue gave in the former 138, as against 42 in the latter, the quotient being = 3·3.

Finally, experiments with light red and dark green gave the respective numbers 168 and 72, or a quotient of 2·3.

We cannot help pointing out how fully these results disagree with the common notion of the beneficial effects of the blue light both upon animal and vegetable life. Our readers will doubtless remember a work written by General Pleasanton, in which the author recommends blue light as a means of promoting the health and vigour of both animals and plants, and even of curing certain diseases. M. Yung, after a series of experiments upon various ova and larvæ, found the action of the colours favourable in the following order: violet, blue, red, yellow, white, and green, the red and green rays being positively hurtful. We must confess that this summary of results obtained by M. Yung, and published in the "Comptes Rendus" of the French Academy of Sciences, seems to us deficient in intelligibility. If the red ray is "positively hurtful," and if yellow and white lights are still less favourable to animal life it must, we think, naturally follow that they are hurtful also. It would therefore seem that further research in this direction is imperatively demanded.

The great sensitiveness of earth-worms both to different intensities and colours of light having been thus demonstrated, Prof. Graber undertook further experiments to test whether the entire skin of the worm is sensitive to light, or, as certain earlier observers have concluded, the anterior portion only. To this end similar series of experiments were undertaken with worms from which the anterior portion of the body had been removed. These experiments gave for light and darkness the quotient 2·6, and for red and blue 2·8. These values are smaller than those obtained with entire worms, but they still permit us to conclude that the entire surface of these animals is sensitive to quantitative and qualitative differences of light.

In view of the sensitiveness of the skin of eyeless animals it became desirable to ascertain the behaviour of the skin of blind animals towards light. For this purpose the sensitiveness of the salamander (it is here doubtful whether Prof. Graber refers to *Salamandra maculata*, or, as would seem from an earlier passage, to *Triton cristatus*) to differences of light was examined, both in its normal state and when blind. Normal salamanders gave in eight enumerations, for the light compartment 1, for the dark 159. With blind salamanders there appeared in eighteen enumerations, in the light cell 135, and in the dark 308. Hence it is legitimately inferred that these animals, even without their eyes, are aware of great differences in the intensity of light.

As regards qualitative differences of light, blind salamanders are also found to be sensitive. The behaviour of the normal salamander was first tested with light red and dark blue light. In ten enumerations there were found 192 in the former, and in the latter 8, the quotient being = 24. With blind salamanders Graber found 536 in the light red, and 406 in the dark blue, or a quotient of 1·3. It is therefore not doubtful that the blind salamander, as well as that possessing normal vision, distinguishes between red and blue, giving the former the preference. When both colours were approximately equal in intensity there were found in the red 474, and in the blue 176, the quotient therefore being = 2·7.

Three further series of experiments were made upon blind salamanders to test their behaviour in white light respectively containing and deprived of the ultra-violet rays. In light which was relatively bright, but free from the ultra-violet rays, there were found 313; in unaltered, but relatively dim light, there were 149, the quotient being = 2·1. A comparison of the two colours green and blue gave, with normal specimens, in the green 299, in the blue 98, or a quotient = 3·1. With blind specimens there were found, in the green 131, in the blue 79, the quotient being = 1·6. For red-green, with blind animals, the quotient was = 1·8, and for red-yellow = 1·4.

It is therefore proved, in the most decided manner, that blind animals are sensitive to quantitative and qualitative differences of light. The signification of this fact may be manifold. The first possibility, that effects of heat are concerned, is excluded by the experiment in which the salamanders were found thermophobic, so that they should shun the red light and seek the blue, whilst the contrary is the case.

Of the two other possibilities, that differences of light are recognised either by their chemical action or by a direct influence upon the sensation of the skin, Prof. Graber decides in favour of the latter, and for the following reason:—Let us suppose the entire sensibility of animals for light were what the theory of Descent demands or seems to demand, —*i.e.*, that the eyes are, indeed, the main organs for the perception of light, but that the skin still takes a certain share therein, since prior to the differentiation of the eyes it was the sole organ for light. Let us then ask what would be, on this supposition, the reactions of normal and of blind salamanders. Two results may naturally be expected;—First, in the blind, and therefore exclusively dermatoptic, animals there would be the same preference for certain kinds of light as in the ophthalmoptic normal individuals. Secondly, the reactions of the former must be decidedly slighter than those of the latter. According to the experiments above described both of these results follow.

It will at once strike the reader that the experiments of Professor Graber have been confined to animals which are lucifugous, light-shunning. With animals which are diurnal, light-loving, it is very possible—indeed probable—that these preferences for colours will be of a very different kind, perhaps even reversed.

VIII. CANINE INTELLIGENCE.

I.

"TO Newton and to Newton's dog Diamond, what a different pair of Universes; while the painting in the optical retina of both was, most likely, the same." So writes Mr. Carlyle in the First Book of his "French Revolution." Different indeed; if we can be permitted without extravagance to speak of the Universe as existing at all for Diamond, or allowed, except in hyperbole, to set side by side a conception of ultimate generality, like the Universe, the summation of all conceptions, and "the painting on the optical retina." Mr. Carlyle's meaning is, however, clear, and his thought profound. Given two different minds, and the same facts: how different are the products! In the thought called up by the sight of the simplest object we give far more than we receive; and what we give is a special resultant of inheritance and individual acquisition. No two of us give the same in amount or in quality. It is not too much to say that for no two human beings is the world we live in quite the same.

And if for no two human beings is the world we live in quite the same, how different must be the world of man from the world of the dog,—the world of Newton from the world of Diamond. It is difficult enough for us to put ourselves in the place of children, of farm labourers, of savages, —to think ourselves into their modes of thought. Difficult or impossible. And yet the *ratio of the senses*, if I may use the expression, is the same, or much the same, for savage and civilised. For both, sight and touch are the dominant senses; hearing, smell, and taste being subsidiary. But in the dog the ratio is by no means the same. Not sight and touch, but sight and smell are the dominant senses. And so great a difference must this alone make that we can but guess what the world of the dog is like. Both in the nature and amount of its *thought*, and in the nature and amount of its *feeling*,—both in its perceptions and in its emotions,—is the canine mind a mystery to us.

But have we any warrant for speaking of thought or of feeling as even existing for the dog? Can we properly speak of a canine mind at all? In their answer to this question untutored Common Sense and the Philosophy of Evolution are at one. It may be a mind of which we know, and from the nature of the case can know, very little; but that there is a brute consciousness clown and naturalist agree. We only know of its existence by inference it is true. Consciousness cannot act on consciousness except by means that are indirect. Mind can never come into direct contact with mind. But that our brothers and sisters have minds like our own, and that Carlo and Pincher have a consciousness that foreshadows our own, is a belief that emerges in childhood, and one that can be justified at a period of maturer thought. The doctrine that animals are automata does not touch this question, for none of the arguments on which that view is based deal at all with the question of consciousness. If they be automata, there is nothing to show that they are not conscious automata. From the nature of their actions we are impelled to believe that, automata or non-automata, they are conscious. And the doctrine of Evolution has furnished a firm basis for that belief. Reject that doctrine, and this firm basis is destroyed. You are ready, with Prof. Max Müller, "to say again and again that, according to the strict rules of positive Philosophy, we have no right to assert or deny anything with reference to the so-called Mind of animals." There are many, however, who regard this belief in animal consciousness as a legitimate scientific conclusion based on the doctrine of Evolution. As such I for one am content to accept it.

Accepting, however, this belief in animal consciousness, we must still remember that both as a *product* and as a *process* animal thought can only be dimly guessed at. As a product we are unable to form any adequate conception of the picture of his surroundings that exists in Carlo's mind. Nor can we by observation learn anything very definite of Carlo's thought as a process. We are forced to judge entirely by inference from observed actions. Even with human beings this is not always by any means a safe process. Still more unsafe is it in dealing with the lower animals.

Are we, then, to leave this subject of Animal Intelligence or Canine Intelligence, to put it in a concrete form, on one side as one in which Science cannot help us? Surely not. Surely we must make the best of the position in which we are inevitably placed. The theory of Evolution and Modern Constructive Psychology have lent to this subject an interest which it hitherto has lacked. They have shown that between Brute Intelligence and Human Intelligence there is organic connection. They have made Comparative Psychology, like Comparative Anatomy, a recognised branch of Science. Our interpretations may be—nay, must be—anthropomorphic; but to-day we are more than ever forced to attempt interpretations of some sort.

Let us now, by way of preface, ascend as rapidly as possible from the very lowest psychological strata.

All those simpler reflex processes which are connected with the continuance of life go on in the dog in much the same way as in man, and are probably as little conscious in the one case as in the other. These are, in fact, in ordinary language, rather vital processes than mental processes. They are, however, undoubtedly *neural* processes. And there are, I think, good grounds for regarding as mental all those processes which are effected by the nervous arc (afferent nerve, ganglion, efferent nerve). Indeed we *must* either do so or regard Mind as a shifting and disconnected phantasmagoria. A great number of reflexes, then, which are effected by the spinal cord, and the nerves connected with this chain of centres, go on in very much the same way in dog and man. So, too, do the still more important reflexes effected by the medulla oblongata. Throughout human and canine life alike this restless little knot of nerve centres is in ceaseless activity. The heart-pulses and the complex mechanism for effecting a variable supply of blood to the bodily organs, the regular sequence of breathing, the insensible perspiration of the skin, the play of the facial muscles, the co-ordinated movements of lips, tongue, palate, and throat which constitute the act of swallowing,—all these in dog and man are under the guidance of the medulla oblongata.

From these we may pass almost insensibly to those more complex reflex actions which are called *instincts*. It is, in fact, impossible to draw any hard and fast line between instincts and reflexes. The only assignable difference is in the complexity of the action. Hence Herbert Spencer's definition of instinct as compound reflex action. Take for example the so-called instinct of taking the breast. Both babe and pup, in common with all the higher Mammalia, come into the world with the suckling instinct in a condition ready for immediate action. There is no learning to suck. And here we come upon a second definition of instinctive action as that which *need not be learnt*, which comes natural as we say. But to be a true instinct it must come natural not to the individual only, but to the species. The word *instinct,* however, is, like a good many others,—reason, sensation, perception, and the like,—extremely indefinite. In such cases the only thing to do is to note the want of definition, and to be on our guard against such confusion as is likely to arise therefrom. Instinctive action, then, in its broader sense is automatic action, action performed without any consciousness of choice. Instinct in the narrower sense is habit which through inheritance comes natural to a species.

The babe and the pup come into the world in such a helpless condition that this suckling instinct is perhaps the only one ready for immediate use, the only one possible to their connate mechanism. Some other creatures, however, make their first appearance with a far more developed connate mechanism. Everyone who has seen a litter of newly born piglings must have been struck by the lively and cheerful activity they at once display. When two or three minutes old they will find their way from one ~~side of~~ the sty to the other, making directly for their mother, guided by her helpful grunts. Mr. D. A. Spalding, by way of experiment, put a little pig in a bag the moment it was born, and kept it there in the dark until it was seven hours old. "I then placed it," he writes, "outside the sty, at a distance of ten feet from where the sow lay concealed inside the house. The pig soon recognised the low grunting of its mother, and went along outside the sty, struggling to get under or over the lower bar. At the end of five minutes it succeeded in forcing itself through, under the bar, at one of the few places where that was possible. No sooner in than it went without a pause into the pig-house to its mother, and was at once like the rest in its behaviour."

The hippopotamus seems to be quite as well off, on making his *debut* in the world, as his cousin. Thunberg, the South African traveller, relates, on the testimony of an experienced hunter, the case of a female hippopotamus who was shot the moment she had given birth to a son and heir. "The Hottentots," he says, "who imagined that after this they could catch the calf alive, immediately rushed out of their hiding-place to lay hold of it, but, though there were several of them, the new-born calf got away from them, and at once made the best of its way to the river."

To the question whether the performance of these instinctive actions is accompanied by consciousness or not, no answer can be given, except the answer that we do not know. They may be conscious, they may not. They may, perhaps, be performed somewhat in the same manner as acts done under mesmeric influence. Merely to hazard a guess—though I think it is a guess that has foundations—I am disposed to think that automatic actions performed immediately after birth, at least in such imperfectly developed creatures as babies and puppies, are unconscious.

Besides those instinctive actions which can be performed at once and without practice immediately after birth, there are other instinctive actions which cannot be performed until the nervous and muscular mechanism is further developed, but which are then performed at once and without practice. Throw a new-born puppy into the river, and after some helpless floundering it will be drowned. Throw its brother, when fully grown, into the river, and, though he may never before have been in water, he will swim to shore. He has not to learn to swim. Swimming is with him an instinctive action. We cannot suppose that this instinctive action is also unconscious. At the same time it is probable that consciousness is occupied with a determination to get to shore, not with a determination to use these or those muscles in a particular way. The dog simply inherits the power which the boy must with some little difficulty acquire. When the boy is swimming leisurely across a river he is scarcely, if at all, conscious of the act of swimming (no more so than he would be under ordinary circumstances of the act of walking); he is only conscious of his wish to pick the water lilies near the further bank.

Instincts are well termed by Herbert Spencer inherited habits; and viewed in this way there is nothing particularly mysterious about most of them. Around some, however, our ignorance, or the limitation of our own powers, throws a halo of wonder. "A hound," for example, "was sent from Newbridge, county Dublin, to Moynalty, county Meath, and thence, long afterwards, conveyed to Dublin. The hound broke loose in Dublin, and the same morning made his way back to his old kennel at Newbridge, thus completing the third side of a triangle by a road he had never travelled in his life." This is but one instance out of many which might be quoted of an animal being guided by a sense of direction. But this sense is so undeveloped, or so very little developed in most of us, though it is possessed to some extent by North American Indians, and, as I am informed on good authority, by Kaffirs, that we are apt to regard it as inexplicable on natural grounds. It may be, however, that M. Cyon's researches on the "semicircular canals," which he regards as the organs of this "sense of space," as he terms it, will throw more light on this subject.

But though instincts may be regarded as inherited habits, we must not suppose that they are in all cases habits intelligently acquired. On the other hand, I presume that in every case of instinct Natural Selection has been a more or less important factor. Or perhaps we may rather say that, with the aid of intelligence or without that aid, all instincts have been formed under the guidance of Natural Selection, such habits as were for the good of the species crystallising, or rather organising, into instincts; such as were detrimental quietly dying out. Or, again, we may say that these insects have been formed under the more general influence of the uniformity of Nature. Let me not be misunderstood here. The *conception* of the uniformity of Nature is one of late development, and is obviously impossible to the animal under any circumstances; but the *influence* of the uniformity of Nature is dominant in every mental, as it is in every physical, process,—mind being throughout its development moulded in conformity with an orderly external sequence of events.

In an animal which has been so long under domestication as the dog, instincts originally acquired under the guidance of Natural Selection may be more or less completely replaced by instincts formed under the guidance of Artificial Selection. Pointing, retrieving, shepherding, may be said to be instinctive in certain breeds of dog. These actions have not now to be learnt. They come natural to the dogs. And they are not only different from, but they are diametrically opposed to, the natural instincts of the canine race.

This modifiability of instinct by artificial selection is a fact of the highest importance. It means nothing less than the alteration of the whole character. The sheep-dog, whose ancestral instincts would prompt him to single out a sheep and pull it down, finds his pleasure in guarding the flock and keeping it together. What was before pleasurable becomes distasteful; pleasure is associated with an altogether new mode of action. For pleasure and pain are the normal incentives to action; and the whole complex process of Evolution has been accompanied by the association of pleasure with such actions as tended to the preservation of the individual and the race, and the association of pain with such actions as were harmful to the individual or the race. It is only in this way that Evolution could be furthered by individual action. Without this association of pleasure with right action, and of pain with wrong action, the Natural Selection of conscious creatures would be impossible. There is a natural selection of *structures* and a natural selection of *actions*. The two must proceed in harmony; and they must be studied side by side. Every structure is or has been *of use*. It has been developed for the furtherance of right action. But right action, if it is to be persisted in by a conscious creature, must be associated directly or indirectly with pleasurable feelings. Nay more, if it is to be persistently persevered in, its non-performance must be associated with that dull form of pain which we call dissatisfaction. Only under these conditions can that form of conduct which leads to the survival of the individual and the race be evolved. The principle of greatest happiness has its roots firmly imbedded in the evolution of conduct throughout the whole realm of conscious existence.

We may say, then, with regard to the mental processes of the dog, so far as we have at present considered or glanced at them, that, first, there are a number of unconscious reflex actions connected with the maintenance of bare life which can only be called mental in the most extended use of that word; that, secondly, there are processes hardly, if at all, to be separated from reflex action, which are performed, perhaps unconsciously, immediately after birth, such as the processes connected with the instinctive act of sucking, &c.; that, thirdly, there are processes which have not to be specially learnt, but come natural at a certain age, such as the act of swimming and the instincts connected with the maintenance of the species, these being evolved under the guidance of Natural Selection; that, fourthly, there are the instinctive habits of pointing, retrieving, and so forth, which also come natural to certain breeds, and which have been evolved under the guidance of Human Selection, whereby a radical change of dog-character has been produced.

(To be continued.)

IX. AN AMERICAN VIEW OF THE VIVISECTION QUESTION.

THE book we take as the basis of our remarks, originally published in England, is one of several recent signs that British physiologists are at last coming to their senses, and, instead of attempting to conceal the fact that they experiment on animals, have decided to explain to the general public what a vivisection is, and why vivisections are necessary. Philanthropos, who is evidently well informed, discusses without passion or prejudice such topics as "What is pain?" "What is cruelty?" "Our rights over animals," "What is vivisection?" "The relation of experiment to physiology," "The relation of medicine to experiment," and so forth. If our colleagues across the water had, some seven or eight years ago, shown sufficient courage to trust to the common sense of the majority of their countrymen, and had endeavoured to inform the laity by securing the publication and distribution of some such book as this, the anti-vivisection legislation could hardly have been enacted. Its passage, and the still-continued agitation for an Act of Parliament totally forbidding all experiment on living animals, prove that the public did not and does not know enough about the matter to save itself from being misled by the reckless misstatements of irresponsible fanatics, and of certain seekers after notoriety or salary.

People in general do not read official blue-books; so, in spite of the fact that the Royal Commisaion appointed to investigate the matter reported that, after prolonged and careful inquiry, it could find no evidence that English physiologists were guilty of cruelty, it has been possible for certain anti-vivisectors, by a persistent course of malignant vituperation and brazen mendacity, to produce a wide-spread belief that vivisection essentially consists in torturing an animal for the object of seeing how much it can suffer without dying. That such is the actual conviction of many worthy men and women in England we know to be the case. The physiologists kept silent, and left the field to their enemies, with disastrous result; no one, not a brute, who believed half the stories circulated, could fail to hate physiology and physiologists. When the railroad stations of

England were placarded with large figures of dissections of dead animals, accompanied by printed words designed to entrap the general public into the belief that they represented vivisections of living creatures; when a text-book of practical physiology, designed only for special students of physiology, was represented far and wide as intended for use by every crude medical student; when the fact that the words "first gave an anæsthetic" were omitted (as they are in text-books of surgery, the administration of an anæsthetic being, of course, assumed in cases where very special reasons for its omission do not exist) in the directions for the performance of certain operations, was used as proof that physiologists never thought of employing means to prevent or minimise pain; when a law was passed which allows any one to torture a frog in the most brutal manner if he says he does it just because he likes it, but subjects a university professor to fine and imprisonment if he draws a drop of blood from the animal's toe for a scientific purpose,—then it had certainly become time for the physicians and physiologists of the British Isles to endeavour to inform the public on the vivisection question.

The anti-vivisection craze has now spread to Germany, and there are premonitory symptoms in the United States. Our people in general are too well informed, and have too great confidence in scientific men, to be so easily led astray as the English have been. We shall, moreover, be free from the pressure of a royal court which dislikes biological science, and from the influence of the personal prejudices of the sovereign, still powerful enough in England to have much weight in legislation on questions outside of Whig and Tory politics. Still, American physiology is by no means secure, unless its leaders take warning by the English disaster. They have, in consequence of British legislation, an opportunity to make the United States the chief seat of physiological research among the English-speaking peoples; and it will be a lasting disgrace to them if they let it slip. If, while freely admitting that they believe it their duty to experiment on living animals, they will be on the alert to correct at once the falsehoods and exaggerations of the fanatics; to take pains to teach the public how much the scientific treatment of disease depends on physiological, therapeutical, and pathological research; and to make it widely known how very small a percentage of vivisections involve more pain than that felt by a man on receiving a hypodermic of morphia,—then there is little doubt they will be allowed to carry on without hindrance their beneficent work. The only danger lies in the ignorance of the great majority of ordinarily well-informed people regarding such subjects. Secrecy, not publicity, is what American physiology has to fear.

[We have great pleasure in placing before our readers the above remarks on the Bestiarian movement, made by our distinguished contemporary "Science," by way of a review of the work of "Philanthropos." See pp. 350 and 411 of our present volume.]

ANALYSES OF BOOKS.

Flowers and their Pedigrees. By GRANT ALLEN. London: Longmans and Co.

WE have here a reproduction of certain botanical essays—conceived under Evolutionist inspiration—which have appeared in various literary journals, and which have done no little towards popularising what may emphatically be called the New Natural History.

That the work before us is interesting and suggestive the author's name will be a sufficient guarantee. Nevertheless there are points brought forward upon which issue may not unfairly be joined.

In the first of the essays before us, the "Daisy's Pedigree," we find a very high claim put in for the great natural order of Compositæ. Says Mr. Allen, "It may perhaps at first hearing sound absurd to say that the daisy group, including these other Composites with tinted rays, forms the very head and crown of the vegetable creation, as man does in the animal creation, and yet it is none the less true. . : . If we take complexity and perfection in the adaptation of the organism to its surroundings as our gauge of comparative evolution, then the daisies must rank in the very first line of plant economy. . . . Thus from the strict biological point of view it becomes quite clear that the daisies, asters, chrysanthemums, and other rayed Composites with coloured outer florets, really stand to other plants in the same relation as man stands to other animals."

However, the author's mind is fortunately not entirely made up. On p. 150 he writes:—"Alike by their inferior ovary, their bilateral shape, their single stamen, their remarkable forms, their brilliant colours, and their occasional mimicry of insect life, the orchids show themselves to be by far the highest of the trinary flowers,—if not, indeed, *of the entire vegetable world.*" This is a different, and we must beg leave to add a much more satisfactory, doctrine. We are, of course, aware that human views of beauty or ugliness cannot be allowed to decide phytological rank. Yet when all due allowance has been made for the Dahlia, the Zinnia, the Cineraria, the Aster, &c., the Compositæ include so many uncomely forms—not forgetting that idol of our modern pseudo-æsthetic school, the sunflower—that we groan in spirit at seeing this order placed at the head of the vegetable world. Hence we cannot but rejoice to find the author, partially at least, questioning the high rank which he has elsewhere claimed for the Compositæ.

In the essay on the Arum, or Cuckoo-pint, we find some statements which may require closer examination. We read:—"The Arum, however, has a still more cruel and insidious mode of procedure [no "cruel and insidious mode" having been previously mentioned]. Its berries are poisonous, and very often, I believe, they destroy the little birds that they have enticed by their delusive prettiness. Then the body of the murdered robin decays away, and forms a mouldering manure-heap from which the young cuckoo-pint derives a fresh store of nutriment. I will not positively assert that it is for this reason the cuckoo-pint has acquired its poisonous juices; but I cannot help saying that if any berry happened to show any tendency in such a direction, and so occasionally poisoned the creatures which eat it, it would thereby obtain an advantage in the struggle for existence, and would tend to increase the poisonous habit so far as it continued to obtain any further advantage by so doing. . . . It has been asked why the birds have not on their side learnt that the Arum is poisonous? The very question shows at once an ingrained inability to understand the working of natural selection. Every bird that eats Arum-berries gets poisoned, but the other birds do not hold a coroner's inquest upon its body, or inquire into the cause of death. Naturally the same bird never eats the berries twice."

Let us, however, even at the risk of being pronounced unable to "understand the working of natural selection," examine the above deliverances a little more closely. Does every bird that eats Arum-berries get poisoned, irrespective of the dose taken, of the other contents of its stomach, or of possible constitutional differences? In default of direct proof that such is the case, we must be permitted to doubt. We find that certain poisonous plants and certain animal matters are rejected as food by animals born and bred in the same district. How can this be except from a tradition—we can use no better term—that such substances are unwholesome? Nor need we wonder how such a tradition can arise. A bird plucks a certain berry; a beast browses certain sprays or twigs to a very small extent, and experiences more or less inconvenience. The knowledge of this fact is transmitted through the species, just as is that of other dangers, and the snare is in course of time avoided, however tempting the bait. It may, indeed, be asked whether "natural selection" does not at times furnish too easy an explanation for phenomena observed. We find a plant elaborating an intense poison. We are told that this is a defensive measure: the plant kills or makes ill such creatures as prey upon it, and their kindred gradually learn caution. Unless this were the case the protection derived from poisonous properties would be but slight. The Arum-berry developes a poison and assumes a brilliant colour that it may be eaten, and with fatal effect. Certain caterpillars, reptiles, &c., having unwholesome properties, are gaily coloured for the very opposite purpose—that they may not be eaten. This subject is in need of a closer examination. Do any of our native birds ever eat the berries of the deadly nightshade, of the bryony, or of the bitter-sweet, and if so with what result? Are birds often found poisoned, save owing to human interference? There is here, we repeat, much room for study and some for experiment, though the latter must be performed in countries where the law has not been moulded to suit the whims of mænad novelists and honorary secretaries.

In two passages Mr. Allen puts on record his aversion to cultivated flowers. Thus he says, "To a botanical eye double flowers, however large and fine, are never really beautiful, because they lack the order and symmetry which appear so conspicuously in the five petals, the clustered stamens, and the regular stigmas of the natural form."

If this is a good and sufficient reason we can only express ourselves devoutly thankful that we have not a "botanical eye." We have seen it elsewhere "ruled"—we think by Mr. Allen—that double flowers cannot be beautiful because they are purposeless. If this canon is to be adopted mankind are greatly to blame for admiring a sunset sky. To what end is all its splendour? As far as we can perceive, a canopy of hodden-grey—such as we too often see—would have answered the very same purposes which follow from a western heaven where day "dies like the dolphin."

One very valuable lesson may be learnt from the book before us,—the low character and standing of yellow flowers. We hope that the neo-æsthetics may be induced to reconsider their love for the sunflower, the daffodil, and the buttercup.

The Standard of Value. By W. L. Jordan, F.R.G.S. Third Edition. London: David Bogue.

The author of this treatise contends that "the double standard of gold and silver was practically the standard of value throughout the civilised world from time immemorial to the year 1873." He asserts that the enormous national debts now existing have been borrowed under that double standard; and for the Governments of the world to legislate in such a manner as to establish a gold standard instead of that double standard constitutes the most gigantic injustice towards the labouring classes who are burdened with those debts that has ever been recorded. If Parliament in 1816 had the right to decree the legal establishment of the gold standard, just after our immense debt of £850,000,000 had been borrowed under the legal existence of the double standard, then a future Parliament, returned by the debtors, who number 10 or 20 to 1 as compared with the creditors, will have an equal right to decree the legal establishment of a silver, a copper, or a paper standard, and thus to make our debt of little value to the holders. For if Parliament has a right to change the standard in such a manner as to *increase* the value of the debt 20 per cent, then it has also a right to change the standard in such a manner as to decrease the value 20 per cent.

Having thus briefly stated the author's views we must decline their discussion as scarcely possible without straying into questions which lie outside our cognizance.

Annual Report of the Board of Regents of the Smithsonian Institution. Showing the Operations, Expenditures, and Condition of the Institution for the year 1881. Washington: Government Printing-Office. 1883.

THIS volume comprises, in addition to the routine proceedings of the Smithsonian Institution, which is in a flourishing condition, a summary of scientific progress for the year 1881.

This survey, appearing so long after its date, will of course have lost some part of its interest, as most of the facts herein recorded have become known to the public through other channels.

The relative amounts of space given to the different sciences is worth notice. To Physics are allotted 46 pages; to Chemistry, 9; whilst Meteorology receives 100 pages, and Anthropology 197.

The predominant space thus allotted to a subject incapable—in the ordinary sense of the term—of "practical application," shows that there must exist in the United States an increasing appreciation for scientific truth, *as such*, and independent of its possible market value.

Zoology receives 91 pages, and of the 17 pages devoted to Botany a portion treats of the researches of Pasteur and others on diseases due to bacteria.

The new National Museum approaches completion, and before this time must have received the collections to be lodged in it, and have undergone the test of actual experience as to the suitability for the purpose intended. The great practical point—at least as far as zoological and botanical collections, and many geological specimens, are concerned—is freedom from damp. We are therefore somewhat startled at reading, in the Report of the Building Commission, that "the patentee of an apparatus for moistening air by means of a system of aspirators, whereby it is claimed that in hot weather a reduction of temperature of eight or ten degrees can be accomplished, has offered to apply his invention to the new building." We should think that in a museum a reduction of summer temperature would be dearly purchased if attended with an increase of moisture. We can only hope that the great Washington Museum may not experience any mishap like that which has occurred at Geneva.

The Artists' Table of Pigments. Showing their Composition, Conditions of Permanency, Non-permanency, and Adulterations, Effects in Combination with other Pigments and Vehicles, and giving the most reliable Tests for Purity. By H. C. STANDAGE. London: Wells, Gardner, Darton, and Co.

WE have here a set of tables which will be exceedingly useful to artists, decorators, and to the manufacturers of paper-hangings. The common names, chemical names and composition, conditions of permanency and non-permanency, possible adulterations, nature of impurities and tests for their detection, are given in parallel columns, with the addition of useful remarks not coming under any of the above-mentioned heads. We regret to find that the chrome-greens are counterfeited by or adulterated with a mixture of chrome-yellow and Prussian blue. Such sophisticated or spurious chrome-greens are not only liable to be attacked and blackened by sulphuretted hydrogen, but are from a sanitary point of view less trustworthy than the genuine greens.

Extract of coffee-berries—*i.e.*, caffeo-viridic acid—is mentioned as an adulterant for sap-green. For ordinary artistic or decorative purposes this addition is to be condemned; but as a colour for the use of confectioners, for staining toys for young children, &c., the coffee-green, being perfectly harmless, is preferable to the buckthorn extract, which is a dangerous irritant.

The synonymy of the green pigments would admit of amendment. Thus there is no mention of Paris green, one of the arsenical copper colours. The looseness of the nomenclature of pigments employed by dealers is even worse than we supposed. Thus we learn from the tables before us that ordinary Brunswick green is made of a mixture of chrome-yellow (chromate of lead) and Prussian blue.

Under "Cœruleum, Cerulian, or Egyptian Blue" we notice an oversight. It is said that this pigment is a "silicate of *cobalt*," and then that it is "artificially made of carbonate of soda, powdered flints, and copper,"—which mixture would, of course, yield a silicate of copper.

Among the adulterations of ultramarine, sugar might have been mentioned as added by some Austrian manufacturers.

Concerning Persian red we are unable to agree with the author. He describes it as a chromate of lead, or in other case a red obtained from ochres. We have always heard the names Persian red, mineral lake, pink colour, and lacque minérale applied to stannates of chrome, the preparation of which may be found in Gentele, and which are much more permanent than the chromates of lead.

"Crimson lake," we read, "is an extract from the *Coccus cacti* insect fixed to oxide of iron or alumina." An almost infinitesimal quantity of oxide of iron is enough to destroy the beauty either of the cochineal or the madder-lakes.

A few typographical errors may be pointed out for rectification in a future edition. Thus in one passage we find "cromate" of potash for chromate; elsewhere "*patassic*" nitrate for potassic; "Jeune" minérale for Jaune, &c.

In some cases also the author makes use of expressions liable to occasion misunderstanding. Thus he states that "Iodine Scarlet" is composed of 200 *equivalents* of mercury and 254 *equivalents* of iodine." "Parts" would be the correct expression, the word used giving a quite erroneous notion of the composition of the pigment.

As a whole, however, we consider that these tables will prove of great value. The price at which they are offered is remarkably low, so as to bring them within the reach of all persons interested in the practical application of pigments.

The Mason College Magazine. Vol. I., No. 8. November, 1883.
Birmingham: Cornish Bros.

This little monthly goes on presenting its readers with not a little matter suggestive of wholesome thought.

We first notice an able paper on the "Study of Modern Languages." The author remarks that "we may claim for linguistic studies that they teach us to know ourselves nationally; to distinguish between the nation of philosophers, the nation of 'bels esprits,' and the nation whose devotion to the industrial arts has won for it the name of a 'nation of shopkeepers.'" It might be added that this sneer comes with scant grace either from the philosophers or the bels esprits, since they have developed such a vehement desire to insinuate themselves behind our counter.

Among the proceedings at the Mason College Union a memoir on the Phrenology of Gall must not be overlooked. The essayist, Mr. Barwise, brought forward some very strong points against that localisation of the mental faculties which some forty years ago had so many adherents. He remarked that little men with big heads are generally the most intellectual. This reminds us of the Byronian couplet:—

"Tall men are oft like houses that are tall,
The upper rooms worst furnished are of all."

We doubt, however, whether the intellectual superiority of little men could be demonstrated statistically.

On another occasion Mr. Greatheed moved the resolution, ultra-heretical in the latitude of Birmingham, that "compulsory education is an obstacle to individual development." As a matter of course he was defeated by a large majority. It may, indeed, be asked whether the suppression of individuality towards which we are hastening, in imitation of the Chinese, is due to the mere fact that education is compulsory, or to other of its features,—to wit, its examinationism and its "standardism." We utterly protest against the assertion of Mr. Ledsam, that "as to the upper classes examinations are beneficial unless the student crams." Mr. Greatheed's views, in our opinion, deserve to be reproduced before a wider public and to be carefully considered.

"Vox Clamantis in Deserto" writes concerning the wild speculations of Mr. George and his followers. "Vox" overlooks, however, the wildest:—"That the earth could maintain a thousand billions of people as easily as a thousand millions is a necessary deduction from the manifest truth that, at least so far as our agency is concerned, matter is eternal, and force must for ever continue to act." Matter may be eternal, but it is not infinite in quantity. We venture to say that there is not in our globe combined nitrogen enough for the bodies of a thousand billion human beings, and at the same time for the animals and plants upon which they must feed, and for the various animal and vegetable parasites which, so far, we have not been able to take even the first step towards extirpating. Before the earth maintains one billion of people in any other state than chronic misery, we must be able to form ammonia on remunerative terms from the nitrogen of the atmosphere, to control the weather, and to exterminate rats, mice, locusts, house-flies, the *Phylloxera*, the *Pteronospora*, the *Hemileia*, and a host of our animal and vegetable rivals in the strife for food. These points, if ever effected, will be due to the quiet labours of the physicist, the chemist, and the biologist, and not to the political agitator.

The Botanic Stand, a Means of Agreeable Instruction in the Knowledge of the Natural Orders of Plants. By THOMAS TWINING. London: David Bogue.

AMONG all *bona fide* teachers of Natural Science—*i.e.*, such as aim at something higher than "preparing" their pupils for an examination—the conviction is fast spreading that instruction should begin with and be based upon things, books being merely referred to secondarily for co-ordinating the knowledge gained in actual practice.

As far as Botany is concerned this method of study is made readily practicable by the suggestion given by Mr. Twining in the pamphlet before us. "The Botanic Stand" is simply a miniature botanic garden. Plants typifying the natural orders are set in flower-pots, and placed along a stand, stage, or shelf, at a height from the ground most convenient for inspection. The last words explain the advantage of this plan as compared with series of plants set in the ground. To examine the latter and watch the development of their characteristics it is necessary either to break off portions or to indulge in prostrations which, especially for ladies, are often neither pleasant nor salutary. By Mr. Twining's scheme, which when once proposed is simple as the traditional egg of Columbus, the student may gain a more intimate acquaintance with plants than from any amount of book-study, even if occasionally aided by reference to dried specimens. The "Stand" is an inexpensive affair, and might, we think, be adopted with much advantage in all schools where Botany is taught. For the details of construction and arrangement we must refer to the pamphlet.

Transactions and Proceedings of the Royal Society of Victoria. Vol. XIX. Issued May 10th, 1883. Melbourne: Mason, Firth, and Co. London: Williams and Norgate.

THE Anniversary Address of the President, Mr. R. L. J. Ellery, F.R.S., the Government Astronomer, contains a few points worthy of notice. Foremost stands the recognition of the priority of Mr. W. Thomson, of South Yarra, as the discoverer of the microbic character of pulmonary consumption. Mr. Thomson's pamphlet was published as early as 1876.

The evil effects produced by the destruction of the forests are recapitulated in the plainest matter. On this point, more than on any other, the future of Australia must hinge.

The Museum at the University is reported as being in an excellent condition; specimens mounted more than twenty years ago still appear quite fresh, owing to the purity of the air.

Among the memoirs inserted in the "Transactions" we notice one, by Mr. James Stirling, on the "Phanerogamous Plants of the Mitta Mitta Source Basin, and their Habitats." The author considers meteorological conditions as exercising a more dominating influence over the growth of plants and in the evolution of varieties than has hitherto been recognised. Whether the chemical variation of soils tends to evolve species is, he thinks, doubtful. On the effects of insect cross-fertilisation he cannot venture an opinion, but suggests that entomological agencies must be subordinated to climatic influences.

Mr. W. Mitten contributes a "Catalogue of Australian Mosses," very valuable for reference.

Dr. Jameson discusses the "Influence of Light on the Development of Bacteria," and concludes that it has little direct influence either in promoting or preventing the growth and multiplication of microbia.

Mr. P. H. MacGillivray contributes a "Description of New or Little-known Polyzoa," which is divided into three portions.

The Rev. J. E. Tenison-Woods, F.L.S., gives a very interesting physical description of the Island of Tasmania.

The Science Monthly. Vol. I., November, 1883. London: D. Bogue and E. W. Allen.

If the number of scientific periodicals may be taken as an indication the public interest in Science, or at least in scientific reading, must be on the increase. Compared with existing journals the "Science Monthly" makes the nearest approach to "Knowledge," both in the subjects embraced and in the general style of treatment.

The principal articles in the present issue are—"The November Star-Shower"; a notice of "Historical Floods," in which a paradoxical attempt is made to show that our climate has improved; "How the Teeth are set on Edge," a study of a common and unpleasant phenomenon not as yet thoroughly understood; "Insect Depredators," a *resumé* of the observations of Miss E. A. Ormerod and others. "Forestry at Home and Abroad" is a brief exposition of the mischief resulting from reckless denudation and of the present modes of forest management. "Weather Lore" is a notice of modern meteorological forecasts, in which some degree of justice is done to those popular empirical rules which we, in these instrument-loving days, are apt to fling aside as mere superstitions. Under the head "Leaders of Science" appears a biographical notice of Sir G. Airy, late Astronomer Royal.

So far we can speak of the contents of this new journal with approval. But under the head "Table Talk" we find, with profound regret, an expression of sympathy with the Bestiarian —*alias* "Anti-Vivisection"—movement. It is painful to see a scientific organ thus aiding and abetting the latest phase of the persecution of Science, and allowing itself to be gulled by the misrepresentations of ignorant and interested persons.

In the "Contributors' Column" is an article on the "Natural Food of Man," which we notice elsewhere, and a letter on that ill-understood pest of Lapland the *Furia infernalis* of Linnæus.

Longman's Magazine. November, 1883. London: Longmans and Co.

This issue contains a paper by R. S. Ball, Astronomer Royal for Ireland, on the "Relation of Darwinism to other Branches of Science." We doubt if it has ever been our lot to meet with so clear and compact an exposition of the principles and foundations of Evolutionism as is given in this essay. The author shows how far the question of the origin of life is from being decided by the negative results of Pasteur and Tyndall.

Dio Lewis's Monthly. Vol. I., No. 3, October, 1883. New York: F. Seaman.

We have here a magazine devoted, it would seem, to philanthropy, hygiene, and kindred subjects. Hence drainage, diet, beer, and nursing are discussed, but the main cause of modern debility, over-work, escapes notice.

In the opening article, "Our Rich Men," we find what to us appears a singular error. To prevent the dangers to the community (real or supposed) arising from the existence of the millionaire, the writer says—"It would be wise as a precautionary measure to keep our eye on the youngsters, and when we find one with a large brain and keen eye, kill him. A standing committee to watch the schools for such boys would be a good practical measure. If you let them live they are almost sure to achieve some provoking success. A still wiser measure would be a monster petition to the Creator praying that all such big-brained, keen-eyed, ingenious, plucky chaps be prevented altogether. If they are allowed to appear among us they are almost sure to make trouble. Some of them will turn out Vanderbilts and Goulds."

Now here, surely, we have the vulgar error that a man's intellect may be measured by his money, and that he who does not grow rich is a fool. Surely Dr. Dio Lewis must know that the big-brained, keen-eyed boy will crave to become a discoverer in Science, a creator in Literature or Art, and unless he inherits a competence is not unlikely to die poor, as many men of genius have done. If it were desirable to weed out from our schools the future plutocrats, the selectors would have to look out for boys of keen but narrow intellect and strong will, acting under the constant impulse of greed.

In an article on the "Treatment of Prisoners" the writer seems to leave out of view the great principle of heredity, and the impossibility of ascertaining whether a criminal is really reclaimed or is merely "biding his time."

Wilford's Microcosm: a Religio-Scientific Monthly, devoted to the Discoveries, Theories, and Investigations of Modern Science in their bearing upon the Religious Thought of the Age, with other Matters of General Interest. Vol. III., No. 3. New York: Hall and Co.

THIS journal declares itself Anti-Evolutionist and Bestiarian, and is consequently, *pro tanto*, outside the scope of our sympathies. It recognises "Realism or Substantialism," and speaks of the nebulous realms of Idealism." Its chief energies seem to be directed against the undulatory theory of sound, and we should infer of light also. The list of contributors includes no writers of any scientific standing, but in return is rich in "Rev. Professors," "Elders," &c.

Not being specialists in Acoustics, we find here nothing worthy of notice.

CORRESPONDENCE.

⁎ The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE IMMUNITY CONFERRED BY AN ATTACK OF CERTAIN CONTAGIOUS DISEASES.

To the Editor of the Journal of Science.

SIR,—Allow me to call your attention to a coincidence. In the "Mason College Magazine" for October, published at the beginning of that month, a correspondent who signs himself "X. Y. *Z*." writes as follows:—"It seems to be, though I am probably uttering a mere truism, long recognised by all acquainted with the subject, that the germ theory gives a clue to the puzzle. The principle seems to be that of the rotation of crops. When the smallpox or vaccine germs are planted in the human body, they, as it were, exhaust the soil by withdrawing from it the special nutriment which they and their kind require. Until the element withdrawn is renewed, which may happen sooner in some constitutions than in others, the patient is not liable to a return of the disease."

In the "Pall Mall Gazette" for October 30th Professor John Tyndall says:—"He (Sir Thomas Watson) once asked me how I supposed the immunity just referred to was to be accounted for? I acknowledged the difficulty, but stated at the same time that the germ theory came nearest to a satisfactory solution. A certain amount of mineral matter was known to be necessary to the constitution of a tree. Without it the tree could not grow, although in comparison with the other constituents of the wood its quantity might be infinitesimal. The exhaustion of a soil often meant the removal from it of a minute but necessary constituent. Reasoning from analogy I ventured to express the opinion that the rarity of second attacks of communicable disease was due to the removal from the system, by the first parasitic crop, of some ingredient necessary to the growth and propagation of the parasite."

Here, surely, is a most curious coincidence.—I am, &c.,

O. P. Q.

WE ARE.

To the Editor of the Journal of Science.

Sir,—It is interesting, at any rate, if not instructive, to look back in history, and see what old fellows who have been dust for centuries used to think on questions that occupy us to-day. L. Botero, a philosopher who flourished as a Jesuit in Elizabeth's reign, looked on the increase of the human species as hindered by the indifference of the State. Now-a-day the question seems more to be, how is it to be kept down on a level with the national wealth? Hallam quotes him to the following effect:—"No encouragement to matrimony, he observes, will increase the numbers of the people without providing also the means of subsistence, and without due care for breeding children up. If this be wanting they either die prematurely or grow up of little service to their country. Why else did the human race reach, three thousand years ago, as great a population as there exists at present? Cities begin with a few inhabitants, increase to a certain point, but do not pass it, as we see at Rome, at Naples, and in other places. Even if all the monks and nuns (!) were to marry there would not, he thinks, be more people in the world than there are; two things being requisite for their increase,—generation and education (or what we should perhaps rather call rearing); and if the multiplication of marriages may promote the one, it certainly hinders the other." Meaning, Hallam concludes, that the poverty attending improvident marriages is the great impediment to rearing their progeny.

Though we are apt selfishly to consider it a blessing there are not more, yet we cannot fail to feel a force in the simple remark of a good old soul:—"Never fear how many children ye bring; the Lord 'll find means for 'em all." Though the human race may outgrow vegetation, it cannot outgrow its own wit.

The vices of humanity have acted perhaps more beneficially to us than we are apt to think. How long is it since the first man died a slave? We cannot tell; nor does any prettily arranged chronological table affect us. Just so long, then, has not the humiliation of man's mind been born, bold aspirations checked, free choice turned to submissive waiting, equality debased to servile worship, sacred feelings outraged and crushed for centuries until they were all but forgotten,—these, and a thousand more, have they not had their effect? Who is to say that much of reverence—our religion—is not the outcome of Slavery? Slaves are not separate beings: it is needless to enumerate how they mix their blood with their "superiors," and idle to show how man attributes debasing actions to the offspring of slaves or inferiors. There is an old pathetic song that has it:—

"They say I cannot love
Because I am a slave!"

War has certainly been a blessing in disguise for ages back. Then, again, Vice begets Immorality, and she is the mother of fewer children than her purer sister. Vice actually keeps down the populations of cities. Why does the political economist omit her from his unproductive persons? Is she not productive in selfish good to the "greatest number"? A former article in your Journal has shown how obligingly useful she is to rid us of our weak-brained competitors in life's struggle: the pity is she is allowed to permeate her rottenness, through Act of Parliament, through the system of every offenceless babe. It is a false sentiment that has any pity for the morally and physically debased. We are too apt to creep as in a dark, strange road, with a wretched lamp. There have been political revolutions and religious revolutions, but no moral revolutions. We allow our laws to make illegitimates and harlots, because the world does so; we continue to force upon our unwilling intellect (and it must have its effect) the fossil ideas of our grandfathers. Both of us may be right; it is a stable that needs a Hercules, only the dung is the landmarks of centuries here. The useless man is voted in the way, and yet the diseased is allowed to marry, the criminal is allowed to breed; and these sons of Cain will wed with the daughters of Seths, and leave us all in a glorious muddle of degeneracy and decay.—I am, &c.,

D. Y. Cliff.

THE BRITISH ASSOCIATION AND THE ENDOWMENT OF RESEARCH.

To the Editor of the Journal of Science.

Sir,—In the Report of the Committee beginning with the "Facial Characteristics of the Races and Principal Crosses in the British Isles," it would seem that that of the Gipsies with native blood has not been included. As regards the "Picts, Angles, and Jutes," it may be said that the impression made by them on the population at large has been confined to the appearance and certain peculiarities of such as possess their blood, as would be shown in the crossing of domestic animals. But when these would become scattered through the population every internal trait of the connexion would be lost, while none of the peculiarities, or none of consequence, would consciously survive, where they lived in a body, beyond some of the ways, folk-lore, or superstitions of the humblest classes of the community. With the Gipsies the case is altogether different, for the reason that they entered Great Britain not later than 1506, and were legally and socially proscribed, and have never been recognised by society in any way. As a migratory, tented, oriental tribe, that exists everywhere, they had, and have yet, a language and signs, and a cast of mind or a soul of nationality peculiar to themselves, with a sympathy, more or less modified, for the same people in every part of the world. The feelings peculiar to the primitive Gipsy are held by the offshoots from the tent, however much the blood is mixed, or improved by the circumstances applying to the ordinary population. As illustrative of this fact we find that Mrs. Carlyle, who was "one of them," was indifferent to her *native* connexion, as fully admitted by Carlyle. The subject of the "Picts, Angles, and Jutes" may be called "dead anthropology," while that of the Gipsies, in all its bearings, is "ethnology on its legs," embracing a large body of people, in many positions in life, existing in the British Islands (as well as in other countries), unacknowledged by the rest of the population. These the British Association seems to have ignored.

With reference to Prof. Ray Lankester's proposal for the "Endowment of Research" I said, in my "Contributions to Natural History, &c.," that original research is "almost invariably, for a time at least, abased or refused the slightest courtesy when something has to give place to what is brought forward" (p. 199); and that Prof. Huxley, when at Baltimore, in September, 1876, "while discouraging the vulgar expedient of offering money for it, said nothing of extending to it the courtesy of discussion through the ordinary channels, doubtless for the reason that that aspect of the question was not specially before the meeting" (p. 200). There are many difficulties attending the "Endowment of Research," under whatever form it might be done; but there should be none in the way of admitting research that has been made by the labour and at the expense of people individually. In that respect zoologists should admit the existence of the research into the question stated by White of Selborne, whether the viper (in common with some other snakes) "opens her mouth and admits her helpless young down her throat on sudden surprises."—I am, &c.,

James Simson.

New York, November 9, 1883.

NOTES.

"Gabriel Max's latest painting is at present on view at Munich, where 'The Vivisector' forms one of the chief attractions of the exhibition at the Odéon. The picture is said to be a marvel of technical execution, but the whole scene appears to be planned in order to startle and to create a sensation, which, like the artist's former works, it does not fail to do."

(It appears that every man in Art, as well as in Literature, who takes his stand upon falsehood must now lift up his heels against physiological experimentation.)

Dr. B. Grassi has at last furnished a complete demonstration that the common house-fly is a great agent in the spread of disease. We have long entertained this view, and have proposed general action for their destruction.

F. W. Parker, Principal of the Cook County Normal School, Illinois, believes that examinations are the greatest curse that schools have.

According to M. Deperet ("Comptes Rendus"), in the Upper Miocene of Pikermi antelopes predominate among the ruminants; the Cervidæ are rare, and the Bovidæ have not yet made their appearance. In the Pliocene of Perrier the antelopes become rare, the Cervidæ are richly developed, and the Bovidæ make their first appearance in Europe.

M. F. van Assche ("Comptes Rendus"), by passing light through a thin film of selenium, succeeds in completely isolating the thermic from the chemical and the luminous undulations.

Science sometimes gets an undeserved compliment. We met lately with this dictum:—"I do not remember ever to have heard of a practical chemist who grew angry if rallied about his chemistry." Yet quite lately a controversy between two German professors of chemistry has ended in the Law-Courts.

It seems that a new Bestiarian organ is to appear, entitled the "Champion." It is to be written in two languages!

"Science" gives a very hostile notice of Prof. Sylvanus Thompson's work on the telephone of Reis. Mr. Barney, in the "Electrical Review," points out that "Science" is published by a company, of which A. Graham Bell is Vice-chairman, and his father-in-law, G. G. Hubbard, one of the Directors!

Dr. T. L. Phipson, writing in the "Chemical News," maintains that plants have no power of decomposing carbonic acid.

An Anti-Vaccination Congress has been held at Berne, under the presidency of M. H. Böens.

"Light" gives instances of the apparition of the spirit of a dog and of a horse, and describes a case where a cat saw and was much terrified at the ghost of a wicked old woman.

A member of the Paris Anthropological Society considered it "not happy" that an autopsy of the brain of the late L. Asseline had brought to light a simian feature.

According to the "American Naturalist" the Colorado beetle is decreasing in numbers in Pennsylvania.

Mr. J. C. Hughes ("Forest and Stream") remarks that the American wolf (*Canis lupus* var. *occidentalis*) feeds, to a large extent during summer, upon various berries, the seeds of which map be abundantly recognised in its excrements.

[This fact is one of many proving how the old arbitrary distinction between carnivorous and herbivorous or fructivorous animals is breaking down.]

The "American Naturalist" writes, somewhat strangely, "There is a duty which every scientific man owes to the community which supports or tolerates [!] him, a duty which becomes greater as his authority and influence are increased in his chosen field. That duty is to present in the vernacular of the people the leading facts in his chosen science." From this view we totally dissent.

The question of the permanence of existing continents and seas is still under discussion in the "Geological Magazine," Prof. Le Conte and S. B. J. Skertchley taking the affirmative side.

It is to be remarked that among Coleopterous insects longitudinal markings occur chiefly in the less highly developed groups, such as Curculionidæ, Longicornes, Chrysomelidæ, &c.

M. Baubigny ("Comptes Rendus") has determined the atomic weight of nickel as 29·372 (that of sulphur being taken as 16·037).

The election of a Lord Rector for Edinburgh University has again been conducted on political principles, Sir Stafford Northcote being the successful candidate.

We are somewhat surprised to find that Mr. A. R. Wallace has given in his adhesion to the Anti-Vaccinationists.

Tarchanoff ("Pflüger's Archiv.") shows that the egg-albumen of those birds whose young are featherless when hatched differs from normal albumen in several of its physical and chemical properties.

An esteemed medical contemporary is exceedingly severe upon the Psychical Research Society.

We copy the subjoined paragraph from the "Medical Press and Circular," as showing how "public opinion" is manufactured :—

"Mr. Jesse, who describes himself as 'Honorary Secretary, Society Abolition Vivisection,' has been fruitlessly wasting the proceeds of his constant appeal for funds in widespread publication of one of our recent notes from abroad in which the details of Biondi's experiments on ablation of the lungs are given. By a curious oversight which would scarcely have been expected in an official so ingenious as the 'Hon. Sec., &c.,' Mr. Jesse has let us into the secret of his endeavours to obtain weight. Within a few days no less than four separate slips of Mr. Jesse's advertisements of the 'Medical Press' have reached the office of that paper, each posted from a different town, the intention doubtless being to delude us into the idea that they were forwarded by indignant readers. But, alas! for the success of the plot, in all cases the extract has been forwarded as sent out by the printer *in proof slips*, Mr. Jesse having, in his hurry to overwhelm, forgotten to cut the edges round, and so ensure its being taken for a veritable newspaper cutting. We have been much amused by the proceeding, and while candidly admitting that we should equally as readily have penetrated any other little device of the kind, we yet offer the 'Society Abolition Vivisection' our sympathy in its failure to arouse more than good-humoured contempt of its weakness."

Judging from the current number of "Light" it would almost seem as if Spiritualism was beginning to make amicable approaches to Astrology and —— Mormonism!

We are inexpressibly disgusted at the following advertisement:—"Wanted, kingfishers, clean and fresh-killed; any quantity." We do not care to say what we wish for the advertiser, or for the paper which inserted his advertisement.

P. Blaserna "Accadem. dei Lincei") maintains that the temperature of the glacial epoch was not necessary, and that glaciers belong to a time when the average temperature of Europe was about 2° C. higher than the present.

A medical contemporary describes a poisoning case due to the consumption of tinned salmon. "The tin in which the fish had been imported was denuded of its inner covering in many places, nitrate of tin being formed." Whence the necessary nitric acid?

The French Commission of Inquiry on the permissibility of the use of salicylic acid in preserving articles of food has reported against the practice, the drug accumulating in the human system.

We learn that Dr. Tanner, known for his fasting performances, has been arrested for practising with a bogus diploma.

According to "Science" a disease similar to *Entomophthora muscæ* in the house-fly has attacked the locust, *Caloptenus differentialis*, and is proving widely fatal.

The "Kansas Review of Science" says, erringly, "Educated men, in Europe, all know the principles of art, its methods, and its schools."

Professor J. Lawrence Smith, the eminent chemist and mineralogist, died recently at his residence in Louisville.

Tellurium, nickel, and cobalt are said to occur in very large quantities in the State of Colorado.

At the Annual Meeting of the Birmingham Suburban Institute Union, Sir Stafford Northcote is reported to have said that he was not a little jealous to see the manner in which the younger sister science had been able to put aside the study of the elder sister literature." This utterance must seem strange when we reflect that Science has not won that independence and equality to which she is entitled, and that Literature, under the name of "general culture," is still forced, as it were, down the throats of those craving for a different diet.

Dr. G. Wyld has engaged in a controversy with the "Medical Press and Circular" on the subject of mind-reading.

At a meeting of pupil-teachers in Westminster, Archdeacon Farrar, whilst admitting the dangers of overwork connected with our present educational system, naïvely advised his hearers to "always endeavour to be cheerful."

On November 15th Professor Osborne Reynolds, F.R.S., delivered a Lecture on "The General Theory of Thermo-dynamics" before the Institution of Civil Engineers.

We learn, with disgust and indignation, that an outrage has been committed on the statue of Liebig, at Munich. The entire left side of the figure—and especially the head, shoulders, and hands—has been drenched with a dark-coloured liquid, which appears to penetrate into the marble.

We regret to put on record the death of Sir William Siemens. Discoverers and inventors die off, whilst speech-makers seem endowed with the longevity of their prototype, the raven.

7·1·84

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